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THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY—VOL. IV.

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY

REPORT

ON THE

SCIENTIFIC RESULTS

OF THE

VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1873-76

UNDER THE COMMAND OF
CAPTAIN GEORGE S. NARES, R.N., F.R.S.
AND
CAPTAIN FRANK TOURLE THOMSON, R.N.

PREPARED UNDER THE SUPERINTENDENCE OF
THE LATE
Sir C. WYVILLE THOMSON, Knt., F.R.S., &c.
REGIUS PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF EDINBURGH
DIRECTOR OF THE CIVILIAN SCIENTIFIC STAFF ON BOARD
AND NOW OF
JOHN MURRAY, F.R.S.E.
ONE OF THE NATURALISTS OF THE EXPEDITION

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY

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ZOOLOGY—VOL. IV.

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THE LATE SIR C. WYVILLE THOMSON.

THE announcement of the death of Sir Charles Wyville Thomson, since the last volume of these Reports was issued from the press, has been received with general regret.

Sir Wyville's name will always be associated with deep-sea investigations, and in a very special manner with those conducted by H.M.S. Challenger. He was one of the chief promoters of the Expedition, and was on board the ship during the whole of her long cruise as Director of the Civilian Scientific Staff. Until the beginning of the present year he had the direction of all the work connected with the publication of these Official Reports.

A subsequent volume will contain a history of the Challenger Expedition, and of those English Expeditions which immediately preceded it, as well as a detailed account of Sir Wyville's scientific work in connection therewith. The present notice is limited to an enumeration of some of the chief events of his life.

Charles Wyville Thomson, the son of Mr. Andrew Thomson, surgeon in the Honourable East India Company's service, was born at Bonsyde, near Linlithgow, on 5th March 1830.

He received his early education at Merchiston Castle School, and afterwards attended the classes in the University of Edinburgh as a student of medicine.

In 1850 he became Lecturer on Botany in King's College, Aberdeen; and in 1851 he was appointed to the Chair of Botany in Marischal College.

In 1853 he was appointed Professor of Natural History in Queen's College, Cork; in 1854 he became Professor of Mineralogy and Geology in Queen's College, Belfast, and afterwards, in 1860, Professor of Natural Science in the same college; in 1868 he held the additional post of Professor of Botany in the Royal College of Science, Dublin.

He was associated with Dr. W. B. Carpenter, C.B., F.R.S., and Dr. J. Gwyn Jeffreys, F.R.S., in the deep-sea explorations in the North Atlantic, conducted by H.M.SS. "Porcupine" and "Lightning" in 1868 and 1869.

In 1870 he was appointed Professor of Natural History in the University of Edinburgh.

In 1872 he obtained leave of absence from the Senatus Academicus of Edinburgh University, on his appointment by the Lords Commissioners of the Admiralty, as Director of the Civilian Scientific Staff on board H.M.S. Challenger.

On the return of the Challenger to England in 1876, he received the honour of knighthood, and was appointed by the Lords Commissioners of Her Majesty's Treasury, Director of the "Challenger Expedition Commission." In the same year he was awarded a Royal medal by the Royal Society for his successful direction of the scientific investigations carried on by H.M.S. Challenger.

In 1877 he was one of the deputation from Edinburgh University to Sweden, on the occasion of the quatercentenary of the foundation of the University of Upsala, and on that occasion was created, by King Oscar, a knight of the Order of the Polar Star.

In 1877 he delivered the Rede Lecture at Cambridge, and in 1878 he was President of the Geographical Section of the British Association at Dublin.

Sir Wyville had a severe illness in the summer of 1879; he continued after that date in failing health, and was not again able to deliver his lectures in the University of Edinburgh. He died at his residence, Bonsyde, near Linlithgow, on the 10th of March 1882.

Sir C. Wyville Thomson was an LL.D. of Aberdeen (1853); F.R.S.E. (1855); an Honorary LL.D. of the Queen's University, Ireland (1860); Fellow of the Royal Irish Academy (1861); F.R.S. London (1869); Honorary D.Sc., Queen's University, Ireland (1871); LL.D. Dublin (1878); Ph.D. Jena; and a Fellow of the Linnean, Geological, Zoological, and Palæontological Societies of London, and of various Foreign and Colonial Institutes.

The following is a list of Sir Wyville Thomson's principal publications:—

On the Application of Photography to the Comp. Microscope, *Brit. Assoc. Rep.*, Part 2, 1850.

Notes on some Scotch Zoophytes and Polyzoa, *Ann. Nat. Hist.*, ix., 1852.

On the Character of the Sertularian Zoophytes, *Brit. Assoc. Rep.*, Part 2, 1852.

Notes on some British Zoophytes, *Ann. Nat. Hist.*, xi., 1853.

On some of the Native Irish Zoophytes, *Nat. Hist. Rev.*, ii., 1855.

On the Embryogeny of *Comatula rosacea*, Linck., *Roy. Soc. Proc.*, ix., 1857–59.

On some Species of *Acidaspis* from Silurian Beds of South of Scotland, *Quart. Jour Geol. Soc.*, 1857.

Description of *Loricula macadami*, a new fossil Cirripede, *Ann. and Mag.*, 1858.

On the Genus and Species of a new Polyzoon, in the collection of Professor Harvey, *Dublin Zool. Bot. Assoc. Proc.*, i., 1859.

On a New Palæozoic Group of the Echinodermata, *Edin. New. Phil. Jour.*, xiii., 1861.

On the Embryology of *Asteracanthion violaceus*, Lin., *Microscopic Soc. Jour.*, i., 1861–62.

On the Development of *Synapta inhærens*, *Microscopic Soc. Jour.*, ii., 1862.

On Distorted Human Skulls, *Nat. Hist. Review*, 1862.

On the Embryology of Echinodermata, *Nat. Hist. Review*, 1863.

Do. do. *do.* 1864.

On Professor Steenstrup's "Views on the Obliquity of Flounders," *Ann. Mag. Nat. Hist.*, 1865.

Sea Lilies (*Cenocrinus—Neocrinus—Comatula*), *Intellect, Obs.*, vi., 1865.

On the Glass Rope (*Hyalonema*), *Intellect, Obs.*, xi., 1867.

On the Vitreous Sponges, *Ann. Mag. Nat. Hist.*, 1868.

On *Holtenia*, a Genus of Vitreous Sponges, *Phil. Trans.*, clix., 1869.

On the Depths of the Sea, *Roy. Dublin Soc. Jour.*, v., 1870.

Osteology of *Polypterus*, *Jour. Anat. and Phys.*, 1870.

On Deep-Sea Climates, *Nature*, ii., 1870.

Preliminary Report, in connection with Drs. W. B. Carpenter and J. G. Jeffreys, of the Scientific Exploration of the Deep-Sea in H.M.S. "Porcupine," *Roy. Soc. Proc.*, xviii., 1870.

On the Distribution of Temperature in the North Atlantic, *Nature*, iv., 1871.

On the Continuity of the Chalk, *Nature*, iii., 1871.

On the Structure of The Palæozoic Crinoids, *Edin. Roy. Soc. Proc.*, vii., 1871.

Notice of a New Family (Echinothuridæ) of the Echinodermata, *Edin. Roy. Soc. Proc.*, vii., 1872.

Deep-Sea Echinidea, *Ann. Mag. Nat. Hist.*, 1872.

On the Crinoidea of the "Porcupine," *Edin. Roy. Soc. Proc.*, vii., 1872.

Opening Address on the Ripening and Decay of Fruit, *Edin. Bot. Soc. Trans.*, 1873.

On the Echinidea of the "Porcupine," *Phil. Trans.*, 1874; *Proc. Roy. Soc.*, 1872.

The Depths of the Sea (1 vol.), 1873. Macmillan & Co. 4to.

On Dredgings and Deep-Sea Soundings in the South Atlantic, in a letter to Admiral Richards, C.B., F.R.S., *Roy. Soc. Proc.*, 1874.

Preliminary Notes on the Nature of the Sea-Bottom, procured by the Soundings of H.M.S. Challenger during her cruise in the Southern Sea in 1874, *Roy. Soc. Proc.*, 1874.

Report to the Admiralty on the Cruise of H.M.S. Challenger from July to November 1874, *Roy. Soc. Proc.*, 1875.

Report to the Admiralty on the Cruise of H.M.S. Challenger from June to August 1875, *Roy. Soc. Proc.*, 1875.

Preliminary Report to Admiralty on Cruise of the Challenger between Hawaii and Valparaiso, *Proc. Roy. Soc.*, 1876.

Preliminary Report to Admiralty on Cruise of the Challenger from Falkland Island to Monte Video, *Proc. Roy. Soc.*, 1876.

On the Structure and Relations of the Genus *Holopus*, *Edin. Roy. Soc. Proc.* 1877.

The Atlantic (2 vols.), 1877. Macmillan & Co. 4to.

Some Peculiarities in the Mode of Propagation of certain Echinoderms of the Southern Sea, *Linn. Soc. Journ. Zoology*, vol. xiii., 1878.

The General Introduction to the Zoological Series of Reports of the Voyage of the Challenger, vol. i., Zool., 1880.

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I.—Report on the Anatomy of the Petrels (*Tubinares*) collected during the Voyage of H.M.S. Challenger, in the years 1873–1876.

By W. A. Forbes, B.A., F.L.S., F.G.S., M.B.O.U., Fellow of St. John's College, Cambridge, Prosector to the Zoological Society of London.

(*Received May* 6, 1882.)

II.—Report on the Deep-Sea Medusæ dredged by H.M.S. Challenger, during the years 1873–1876.

By Professor Ernst Haeckel, M.D., Ph.D.

(*Received March* 1, 1881.)

III.—Report on the Holothurioidea, dredged by H.M.S. Challenger during the years 1873–1876. Part I.

By Hjalmar Théel.

(*Received June* 1, 1881.)

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY

EDITORIAL NOTES.

AFTER the lamented death of Professor A. H. Garrod, Mr. W. A. Forbes was induced to undertake the anatomical examination of the Petrels collected during the cruise of the Challenger. The result of Mr. Forbes' labours is given in the first Report in this volume. This contribution will be found a most valuable addition to the literature on this remarkable order of Pelagic birds.

The name which has been given to Professor Haeckel's beautifully illustrated Memoir may perhaps be open to question. Some of the species described are certainly from the surface, and it is even doubtful if all the others are to be regarded as true deep-sea animals.

Professor Haeckel discusses this question in his Preface, and I quite agree with him in regarding some of the forms as constant inhabitants of the deep sea.

In Dr. Théel's Memoir we have the description of a new order of characteristic deep-sea animals of very great interest.

The majority of the Elasipoda live in depths greater than 1000 fathoms, and up to the present time only one species has been found in depths less than 100 fathoms. This species was dredged in the Arctic Ocean, during the Swedish Expedition to the Yenisei in the year 1875, and was described by Dr. Théel shortly after the return of the Challenger to England. This circumstance led to the whole of the Holothurioidea of the Challenger Expedition being placed in Dr. Théel's hands for description. Dr. Théel promises the second part of his very valuable contribution in the course of a few months.

Owing to the continued ill-health of the late Sir C. Wyville Thomson, I was, in January of the present year, instructed to undertake the Editorial duties connected with the Official Publications on the Scientific Results of the Challenger Expedition; and, at the same time was requested to prepare, for the information of H.M. Government, a Report on the state of the work in connection therewith.

The List which is here annexed shows the Memoirs already published, and those in progress or about to be undertaken on the 1st of April 1882—the commencement of the current financial year.

JOHN MURRAY.

PUBLISHED MEMOIRS.

GENERAL INTRODUCTION TO THE ZOOLOGICAL SERIES OF REPORTS.
By Sir C. WYVILLE THOMSON, Knt., F.R.S., &c.

REPORT ON THE BRACHIOPODA.
By THOMAS DAVIDSON, F.R.S., F.L.S., F.G.S., V.-P.P.S., &c.

REPORT ON THE PENNATULIDA.
By Professor ALBERT V. KÖLLIKER, F.M.R.S., &c.

REPORT ON THE OSTRACODA.
By G. STEWARDSON BRADY, M.D., F.L.S.

REPORT ON THE BONES OF CETACEA.
By Professor WILLIAM TURNER, M.B. (Lond.), F.R.SS. L. & E.

REPORT ON THE DEVELOPMENT OF THE GREEN TURTLE.
By WILLIAM KITCHEN PARKER, F.R.S., F.L.S., F.Z.S.

REPORT ON THE SHORE FISHES.
By ALBERT GÜNTHER, M.A., M.D., Ph.D., F.R.S., &c.

REPORT ON THE CORALS.
By Professor H. N. MOSELEY, M.A., F.R.S.

REPORT ON THE BIRDS.

a. ON THE BIRDS COLLECTED IN THE PHILIPPINE ISLANDS.
By ARTHUR, MARQUIS OF TWEEDDALE, F.R.S.S. L. & E., &c.

β. On the Birds collected in the Admiralty Islands.
By P. L. Sclater, M.A., Ph.D., F.R.S.

γ. On the Birds collected in Tongatabu, the Fiji Islands, Api (New Hebrides), and Tahiti.
By O. Finsch, C.M.Z.S.

δ. On the Birds collected in Ternate, Amboyna, Banda, the Ki Islands, and the Arrou Islands.
By T. Salvadori, C.M.Z.S.

ε. On the Birds collected at Cape York, Australia, and on the Neighbouring Islands (Raine, Wednesday, and Booby Islands).
By W. A. Forbes, B.A., F.L.S., F.G.S., F.Z.S.

ζ. On the Birds collected in the Sandwich Islands.
By P. L. Sclater, M.A., Ph.D., F.R.S., F.L.S.

η. On the Birds collected in Antarctic America.
By P. L. Sclater, M.A., Ph.D., F.R.S., and Osbert Salvin, M.A., F.R.S.

θ. On the Birds collected on the Atlantic Islands, and Kerguelen Island, and on the Miscellaneous Collections.
By P. L. Sclater, M.A., Ph.D., F.R.S.

ι. On the Steganopodes and Impennes.
By P. L. Sclater, M.A., Ph.D., F.R.S., and Osbert Salvin, M.A., F.R.S., F.L.S.

κ. On the Laridæ.
By Howard Saunders, F.R.S., F.L.S.

λ. On the Procellaridæ.
By Osbert Salvin, M.A., F.R.S., &c.

μ. List of the Eggs collected.
By P. L. Sclater, M.A., Ph.D., F.R.S., F.L.S.

ν. Note on the Gizzard and other Organs of *Carpophaga latrans*.
By A. H. Garrod, M.A., F.R.S.

Report on the Echinoidea.
By Alexander Agassiz.

Report on the Pycnogonida.
By P. P. C. Hoek.

MEMOIRS TO APPEAR IN THE FINANCIAL YEAR 1882–83.

REPORT ON THE ANATOMY OF THE PETRELS.
By W. A. FORBES, B.A., F.L.S., F.G.S., F.Z.S.

REPORT ON THE HOLOTHURIOIDEA. Part I.
By HJALMAR THÉEL.

REPORT ON THE DEEP-SEA MEDUSÆ.
By Professor ERNST HAECKEL, M.D., Ph.D.

REPORT ON THE OPHIUROIDEA.
By THEODORE LYMAN.

REPORT ON THE ACTINIARIA.
By Professor RICHARD HERTWIG.

REPORT ON THE PETROLOGY OF ST. PAUL'S ROCKS.
By Professor A. RENARD, F.G.S.

REPORT ON THE PRESSURE ERRORS OF THE CHALLENGER THERMOMETERS.
By Professor P. G. TAIT, M.A., Sec. R.S.E.

MAGNETICAL RESULTS.
By Commander MACLEAR, R.N.; Lieutenant BROMLEY, R.N.; Staff-Commander TIZARD, R.N.; and Staff-Commander E. W. CREAK, R.N.; with Instructions and Memorandum prepared under the Superintendence of the Hydrographer of the Admiralty.

METEOROLOGICAL OBSERVATIONS.
By Staff-Commander TIZARD, R.N., assisted by other Officers of the Ship.

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By GEORGE BUSK, F.R.S., V.-P.L.S., F.G.S., F.R.C.S.

REPORT ON THE HYDROIDA. Part I.
By Professor G. J. ALLMAN, M.D., LL.D., F.R.SS. L. and E., M.R.I.A., V.-P.L.S.

REPORT ON THE ANATOMY OF THE SPHENISCIDÆ. Part I.
By Professor MORRISON WATSON, M.D., F.R.S.E.

REPORT ON THE MARSUPIALIA.
By Professor D. J. CUNNINGHAM, M.D., F.R.S.E., F.R.C.S.

REPORT ON THE COPEPODA.
By G. STEWARDSON BRADY, M.D., F.R.S., F.L.S.

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By RUDOLPH BERGH.

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By Professor W. DITTMAR, F.R.SS. L. and E.

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SPECIFIC GRAVITY OBSERVATIONS.
By J. Y. BUCHANAN, M.A., F.R.S.E.

REPORT ON DIATOMACEÆ.
By CONTE ABATE FRANCESCO CASTRACANE.

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By Professor W. A. HERDMAN, D.Sc., F.R.S.E.

REPORT ON THE GENUS ORBITOLITES.
By W. B. CARPENTER, C.B., M.D., LL.D., F.R.S., F.G.S., V.-P.L.S., &c.

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By F. BUCHANAN WHITE, M.D., F.L.S.

MEMOIRS TO FOLLOW IN SUBSEQUENT YEARS.

REPORT ON THE HOLOTHURIOIDEA. Part II.
By HJALMAR THÉEL.

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By GEORGE BUSK, F.R.S., V.P.L.S., F.R.C.S., F.G.S.

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REPORT ON THE RADIOLARIA.
By Professor ERNST HAECKEL, M.D., Ph.D.

THE NARRATIVE OF THE VOYAGE. (Vol. I.)
By Staff-Commander TIZARD, R.N., Professor H. N. MOSELEY, F.R.S., J. Y. BUCHANAN, M.A., F.R.S.E., and JOHN MURRAY, F.R.S.E.

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By Professor E. PERCEVAL WRIGHT, M.D., F.L.S.

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By Professor E. RAY LANKESTER, M.A., F.R.S., F.L.S.

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REPORT ON THE ANNELIDA
By W. C. M'INTOSH, M.D., LL.D., F.R.SS. L. and E., F.L.S., &c.

REPORT ON THE CUMACEA AND SCHIZOPODA.
By

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By Professor MORRISON WATSON, M.D., F.R.S.E.

REPORT ON THE GASTEROPODA.
By the Rev. R. BOOG WATSON, F.R.S.E., F.L.S., and the MARQUIS DE FOLIN.

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REPORT ON THE LAMELLIBRANCHIATA.
By E. A. SMITH.

THE ANATOMY OF THE DEEP-SEA MOLLUSCA.
By

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By Professor P. G. TAIT, M.A., Sec. R.S.E., and ALEXANDER BUCHAN, M.A., F.R.S.E.

THE ANATOMY OF PERIPATUS.
By Professor F. M. BALFOUR, M.A., F.R.S.

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By S. O. RIDLEY, F.L.S.

REPORT ON THE TETRACTINELLIDÆ.
By Professor W. J. SOLLAS, M.A., F.R.S.E.

REPORT ON THE BRACHYURA.
By E. J. MIERS, F.L.S.

REPORT ON THE AMPHIPODA.
By the Rev. T. R. R. STEBBING.

REPORT ON THE STOMATOPODA.
By

REPORT ON THE ANOMURA.
By JULES BARROIS, Director of the Zoological Laboratory at Villefranche.

REPORT ON THE PTEROPODA AND HETEROPODA.
By A. E. CRAVEN, F.L.S., F.G.S.

CONCLUDING PART WITH INDEX.
By JOHN MURRAY, F.R.S.E.

THE ISOPODA, and one or two other Groups still remain to be allotted.

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the ANATOMY of the PETRELS (*Tubinares*), collected during the Voyage of H.M.S. Challenger. By W. A. FORBES, B.A., F.L.S., F.G.S., M.B.O.U., Fellow of St. John's College, Cambridge, Prosector to the Zoological Society of London.

I. INTRODUCTORY.

MATERIALS for the knowledge of the structure of the soft parts of the class Aves, when the members of that group indigenous to a country have been examined, are for the most part only to be obtained through the medium of zoological gardens, by the inhabitants of these, on their decease, coming into the hands of some person competent to examine them. In spite of the increased facilities of communication of the present day, and the greater experience of those in charge of living zoological collections, there still remain many groups of birds which as yet it has been found impossible to obtain or keep in a living state. Such birds in consequence can only be adequately studied from spirit-specimens, and these also it is frequently very difficult to obtain, especially if the species wanted are of large size, or inhabit little explored and inaccessible countries.

The group of PETRELS is one that has till the present been hardly at all examined anatomically, as but few species inhabit the European seas, and even these, on account of their peculiar habits, are rarely to be obtained in the flesh, either in a living or dead state. The majority of the group, inhabiting the little visited oceans and islands of the Southern Hemisphere, have been known simply from skins or skeletons, the great size of many of them rendering bringing their bodies home in spirit impracticable to any ordinary collector. Nor have we as yet succeeded in obtaining or keeping any in a living state, except on one or two rare occasions.

When therefore H.M.S. Challenger was starting on her voyage of circumnavigation it seemed that an excellent opportunity would be afforded for obtaining material to fill up the blank that thus existed in our knowledge of the Petrels. At the suggestion of my lamented predecessor Prof. A. H. Garrod, at that time Prosector to the Zoological Society, the naturalist staff was requested to pay special attention to forming a collection of these oceanic birds in spirit, so as to be available for anatomical examination. The result was a very considerable collection indeed of the birds in question, all excellently preserved, and including nearly all the most important and interesting of the known genera. These were handed over, when the collections were being broken up for working out, to Professor Garrod for examination. Unfortunately he had hardly commenced to work seriously on them before he was struck down by the lingering illness which eventually proved fatal to him. During that time, whenever well enough to do so, he continued to work away at his favourite subject, and many of his drawings made then, chiefly relating to the conformation of the syrinx in these birds, are now before me. An unfinished MS. paper of his written about that time, treating on the anatomy of the Diving Petrel (*Pelecanoïdes*)—a form the Procellarian affinities of which were then doubtful—was sufficiently complete and important to justify, in the writer's opinion, its publication in the reprint of Professor Garrod's papers which has since been edited by him.

Succeeding to Professor Garrod's position at the Zoological Gardens early in 1880, I applied immediately to the late Professor Sir Wyville Thomson to be allowed to retain so much of the material collected by the Challenger as was likely to prove of service to me in my researches on the anatomy of birds, and I especially asked to be allowed to retain the collection of Petrels, with the object of drawing up a report thereon for the present series of papers. I must take this opportunity to record my best thanks to Sir Wyville Thomson for the very ready way in which he acceded to both my requests. Having commenced work on the specimens of Petrels collected by the Challenger it seemed desirable to make my report on the structure of that group as perfect and complete as possible, and during the past two years I have therefore taken every opportunity of acquiring specimens of them fit for dissection. By these means I have been enabled to examine several species and genera of these birds not represented in the Challenger collection, though that collection has formed the groundwork of my investigations.

I herewith give a complete list of those species that I have been enabled to examine in the flesh. All not otherwise indicated were collected by H.M.S. Challenger. And I must take this opportunity to thank my friend Mr. Osbert Salvin, F.R.S., who reported on the collection of Tubinares made in skins during the voyage,[1] for his kind assistance in naming the spirit-specimens under my charge, as well as for much subsequent assistance in points of nomenclature, and for valuable material that would not have otherwise been available.

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[1] Zoology of the Voyage of H.M.S. Challenger, vol. ii. part viii. pp. 140–149 (Report on the Birds—XI. On the Procellariidæ collected during the Expedition). Also Proc. Zool. Soc., 1878, pp. 735–740.

List of Material Examined.

Name of Bird.	Number of Specimens.	Remarks.
OCEANITIDÆ—		
Oceanites oceanicus,	3	One from the Smithsonian Institution.
Garrodia nereis,	4	One from the Godeffroy Museum in Hamburg. The other three old specimens from the Museum of the Royal College of Surgeons.
Pelagodroma marina,	1	
Fregetta grallaria,	2	One a skinned trunk.
„ *melanogastra*,	2	From the Godeffroy Museum.
PROCELLARIIDÆ—		
Halocyptena microsoma,	1	(I must thank Mr. Salvin for his kindness in allowing me to dissect his spirit-specimen of this extremely rare bird, previously only known from the type-specimen in the Smithsonian Institution.)
Procellaria pelagica,	3	Prosector's stores.
Cymochorea leucorrhoa,	5	Two, one a chick, from the Smithsonian Institution. Three from Prosector's stores.
Bulweria columbina,	1	O. Salvin, Esq.
„ *macgillivrayi*,	1	Received from Canon Tristram (skinned trunk only).
Œstrelata mollis,	1	An old specimen from the College of Surgeons.
„ *lessoni*,	1	
„ sp. inc.,	1	
„ *brevirostris*,	8	All young (two from the Transit Expedition).
Majaqueus æquinoctialis,	3	One young.
Puffinus obscurus,	4	
„ *brevicauda*,	3	
Pagodroma nivea,	1	
Daption capensis,	2	One from the Zoological Society's Gardens.
Aeipetes[1] *antarcticus*,	2	
Thalassœca glacialoides,	1	
Fulmarus glacialis,	2	Zoological Society's Gardens.
Ossifraga gigantea,	2	One, a nestling, from the Transit Expedition.
Prion vittatus,	1	
„ *banksi*,	2	One from Celebes (O. Salvin, Esq.), one from the College of Surgeons.
„ *desolatus*,	4	One a chick.
Pelecanoïdes urinatrix,	7	Two young.
Diomedea brachyura,	2	
„ *exulans*,	2	
Thalassiarche culminata,	1	
Phœbetria fuliginosa,	1	A nestling.

In all thirty-one species, represented by seventy-four specimens and belonging to twenty-two different genera. Besides the above, which only represent entire birds, there were a number of separate heads, which have been cleaned, and will be found enumerated below in the list of osteological material in this group examined by me.

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[1] For the characters of this new genus, *vide infra*, p. 59.

II. PREVIOUS LITERATURE ON THE ANATOMY AND CLASSIFICATION OF THE *TUBINARES.*

I propose under this head to briefly notice the more important papers or memoirs that have appeared dealing with the structure and classification of these birds. Titles of several less important ones not mentioned here may be found duly recorded in the third instalment of Dr. Coues' Ornithological Biography,[1] Procellariidæ, pp. 1021–1033.

1826. One of the very earliest contributions to the anatomy of the Petrels we owe to the voyage of circumnavigation made by the "Coquille." Garnot, in the account of that expedition,[2] gives some brief anatomical notices chiefly relating to the digestive organs of several Tubinares. The species dissected are, unfortunately, not referred to by scientific names, but they appear to be *Phœbetria fuliginosa, Thalassœca glacialoides,* a *Prion, Fregetta melanogastra,* and *Pelecanoïdes urinatrix,* as well as another species I cannot determine ("Petrel de la Mer Pacifique").

In 1827 L'herminier[3] described the general character of the sternum of the Tubinares, which formed his twenty-eighth family of birds, and proposed to divide the group up, on sternal characters, into three sections—(1) the smaller Petrels (*Procellaria, Cymochorea,* &c.) with the posterior margin of the sternum more or less entire; (2) the Albatrosses, with the sternum with two large and shallow excavations posteriorly; and (3) the Petrels proper, with four posterior sternal excavations. As regards the general position of the group, he remarks:—"Ces oiseaux . . . par la forme de l'appareil sternal, sont intermédiaires aux mouettes et aux pélicans." On plate iv. of the plates illustrating his memoir, two figures of the sternum of a *Puffinus* are given.

1838–39. W. Macgillivray, in Audubon's Ornithological Biography,[4] describes and figures the alimentary canal and trachea of two species of Petrels, namely, *Oceanites oceanicus* (vol. v. pp. 645–646) and of *Procellaria pelagica* (vol. iv. pp. 313–315).

In the second part of the same author's Manual of British Ornithology[5] are given a few notes on the visceral anatomy of the British species of the group.

In the same year J. F. Brandt, in his Beiträge zur Naturgeschichte der Vogel,[6] called attention to the existence of a peculiar ossicle, connected with the lachrymal and palatine bones, and hence called "ossiculum lacrymo-palatinum," which he had discovered in many of the Tubinares and also in *Fregata aquila.*

1840. It is to Nitzsch, perhaps the most acute and original ornithologist that ever lived, that we are indebted for nearly our whole existing knowledge of the important subject of the pterylosis of birds. In his classical, though posthumous, Pterylographie the Nasutæ seu Tubinares form the second group of his order Natatores, and the pterylosis of the group is described at some length. Further details of Nitzsch's observations are recorded below (*infra*, p. 14) in the space devoted to the consideration of the pterylographical characters of these birds. So far as I am aware nothing else was contributed by Nitzsch to our knowledge of this group.

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[1] Bull. U. S. Geol. Surv., vol. v., No. 4, Washington, 1880.

[2] Voyage autour de la Monde, Zool., tom. i.; Recherches anatomiques relatives a divers oiseaux marins, pp. 603–612.

[3] Recherches sur l'appareil sternal des Oiseaux, pp. 79–81, vol. iv., Paris, 1827.

[4] Edinburgh, 1839.

[5] London, 1842, pp. 258–264.

[6] Beiträge zur Kenntniss der Naturgeschichte der Vögel, St. Petersburg, 1839, pp. 4–9.

In the same year as that in which the Pterylographie appeared, Rudolph Wagner, a disciple of Nitzsch's, contributed to the tenth volume of Naumann's Vögel Deutschlands[1] some remarks on the anatomical structure of three genera of Tubinares included in that work, namely, *Procellaria*, *Fulmarus*, and *Puffinus*. These consisted of short notes on the skeleton and the thoracic and abdominal viscera, and, as far as they go, are accurate enough. The general similarity in structure of the members of this group examined, as well as of *Diomedea*, is noted, as well as many points of resemblance to the Laridæ, and particularly *Lestris*.

In the year 1844 MM. Hombron and Jacquinot communicated to the Academy of Sciences in Paris a paper entitled "Remarques sur quelques points de l'anatomie et de la physiologie des Procellaridées, et essai d'une nouvelle classification de ces oiseaux." An abstract, by the authors, is published in the Comptes Rendus for that year.[2] The material for their paper was obtained, I may remark, during the expedition of the French ships "Astrolabe" and "Zélée," commonly known as the Voyage au Pôle Sud. Basing their classification on the form and structure of the beak, palate, and tongue, they divide up the group as follows :—

1. Borders of mandibles excavated by a longitudinal furrow dividing them into inner and outer cutting surfaces. Tongue small, one-third the length of beak, sagittate, posteriorly and laterally denticulate.

Three genera—*Diomedea*; *Puffinus*, subdivided into *Puffinus* proper (*anglorum*, *obscurus*, *fuliginosus*?, &c.) and *Priofinus* (*cinereus*, *æquinoctialis*, *arcticus*?); and *Thalassidroma* (*pelagica*, *leachii* [=*leucorrhoa*], *oceanica*, *fregetta* [=*grallaria*], *marina*.

2. Edges of upper mandible with transverse lamellæ. Tongue as long as the beak, large and thick, only free at the apex.

One genus, *Prion*, divided into five sub-genera—*Prion s.s.*, *Daption*, *Fulmarus*, *Ossifraga*, and *Priocella* (for *Priocella garnoti* = *Thalassæca glacialoides* of this paper).

3. Mandibles simple, with no double cutting-edges or transverse lamellæ, but with two slight, elongated "teeth"; palate smooth or nearly so; tongue of intermediate length.

One genus, *Procellaria*, separated into two groups, one with the beak quite short (*nivea*, *desolata*, *brevirostris*), the other with it long (*antarctica*, *lessoni*, *hæsitata*, Forst. [? = *Adamastor cinereus*]).

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[1] *Loc. cit.*, pp. 555–656, 587–588, 614–617.

[2] *Loc. cit.*, tom. xviii. pp. 353–358.

These points are illustrated in the atlas to the Voyage au Pôle Sud (pl. xxxii.), the classification adopted being explained in the text (vol. iii. pp. 143-152) published some years later.

The genus *Pelecanoïdes* is expressly excluded from the Petrels by these authors, according to whom it is closely allied to the Little Auk (*Alle nigricans*) of our northern seas.

1849. Gray and Mitchell, in the Genera of Birds,[1] make the Procellariidæ the fourth family of their Anseres. They are subdivided into the Diomedeinæ (of one genus) and the Procellariinæ, of which latter five genera are recognised (*Prion, Pelecanoïdes, Procellaria, Thalassidroma,* and *Puffinus*). The most characteristic generic characters of these are figured on plate 178.

1857. Bonaparte in his Conspectus[2] gives a list of the then known genera and species of the Procellariidæ, which he divides into three sub-families, Diomedeinæ (*Diomedea*), Procellariinæ, and Halodrominæ. The Procellariinæ again are divided into five smaller groups, designated by letters as follows:—

A. Fulmareæ—
    Ossifraga, Fulmarus, Adamastor, Daption.
B. Œstrelateæ—
    Œstrelata, Cookilaria, Pterodroma, Thalassœca, Pagodroma.
C. Prioneæ—
    Prion, Halobæna.
D. Procellarieæ—
    "**Unguibus compressis*"; *Bulweria, Oceanodroma, Thalassidroma, Procellaria.*
    "***Unguibus depressis*"; *Fregetta, Pelagodroma, Oceanites.*
E. Puffineæ—
    Majaqueus, Thiellus, Nectris, Puffinus.

1866.—In this year Dr. Elliott Coues completed his Critical Review of the family Procellariidæ commenced in 1864.[3]

This is the most complete account yet published of the synonymy and distribution of the species of this group, which is divided into 24 genera, containing 92 species (17 of these being doubtful). Following Bonaparte, the same three sub-families are adopted, the Procellariinæ, as before, being subdivided into five groups.

The genera composing these are as follows:—

Section Procellarieæ—
    Oceanodroma, Cymochorea, Halocyptena (gen. nov.), *Procellaria, Oceanites, Fregetta, Pelagodroma.*

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[1] *Loc. cit.*, iii. pp. 646-650.

[2] Conspectus generum avium, tom. ii. pp. 184-206.

[3] Proc. Ac. Nat. Sci. Philad., 1864, pp. 72-91 (part 1), and pp. 116-144 (part 2); *loc. cit.*, 1866, pp. 25-33, (part 3), pp. 134-197 (parts 4 and 5).

Section Puffineæ—
Majaqueus, Adamastor, Thiellus, Nectris, Puffinus.
Section Œstrelateæ—
Œstrelata, Pagodroma, Daption.
Section Prioneæ—
Halobæna, Pseudoprion, Prion.
Section Fulmareæ—
Fulmarus, Thalassœca, Ossifraga.

Although the names of these five sections are the same as Bonaparte's, yet the genera included in them are, it will be seen, different, the arrangement in many respects being more natural.

1867. Eyton in his Osteologia Avium[1] describes briefly some of the more salient features of the osteology of *Ossifraga gigantea, Diomedea exulans* and *fuliginosa, Puffinus major* (and another undetermined species), and *Thalassidroma oceanica* (= ? *Oceanites*). The skeletons of the *Ossifraga, Diomedea exulans,* and *Thalassidroma* are figured, with details of some of the bones.

The same year witnessed the publication of M. Alphonse Milne-Edward's great work on fossil birds.[2] Pages 301–341 of the first volume are devoted to the consideration of the osteology of the living Longipennes, composed of the Gulls (Laridæ) and Petrels (Procellariidæ). The Petrels are considered to be, as regards their osteological characters, allied most closely to the Gulls, with some resemblances to the Steganopodes. "Par quelques-uns de leur caractères, les Procellarides se lient aux Totipalmes. Ainsi on ne peut se refuser à reconnâitre une grande ressemblance entre la constitution de la charpente osseuse des Frégates, des Phaétons, c'est-á-dire des Totipalmes grand voiliers et celle des Pétrels ou des Puffins. Cette analogie a d'ailleurs été parfaitement saisie par L'herminier, qui cependant n'avait étudié que la conformation de l'appareil sternal" (*loc. cit.*, pp. 302, 303).

A complete skeleton of *Prion vittatus* is figured on plate l. fig. 1, with numerous details of the bones of *Puffinus cinereus*—skull (pl. xlix. fig. 12), leg-bones (pl. li.), pelvis and humerus (pl. lii.), sternum and scapular arch (pl. liii.).

Hydrornis natator (pp. 362–365, pl. lvii. figs 18–22), from the Miocene deposits of Langy, is perhaps allied to the Shearwaters (*Puffinus*), but the remains found (a tarso-metatarsus, and a femur of doubtful ownership) do not suffice to decide the point certainly.

Professor Huxley[3] places the Petrels with the Gulls, Divers, and Auks in the group Cecomorphæ of his Schizognathous series. Respecting their palate we read—"The Procellariidæ differ from the families which have just been enumerated (Gulls, Divers, Grebes, Auks, and Penguins) in the great expansion of the maxillo-palatines which become thick and spongy, and so closely approach the middle line that, in the Albatrosses, only a very narrow cleft is left on each side of the vomer. The front part of the vomer itself is much more strongly bent downwards than in the Gulls; and the ascending process of the palatine bone is greatly produced, and becomes anchylosed with the vomer. *Procellaria gigas* [*i.e.*, *Ossifraga*] holds a sort of intermediate place between the Gulls and the Albatrosses, the maxillo-palatines being less swollen, and the clefts between them and the vomer far larger than in *Diomedea*. In this species again the basipterygoid processes are present, though I have not been able to observe them in other Procellariidæ" (*loc. cit.*, pp. 430, 431). [As regards this last sentence, as will be seen below, such basipterygoid processes are the rule and not the exception in this group.] In illustration of these remarks, views of the palate of "*Procellaria*" *gigantea* and *Diomedea exulans* are given.

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[1] London, 1867, pp. 221–225.

[2] Recherches anatomiques et paléontologiques pour servir à l'histoire des oiseaux fossiles de la France, Paris, 1867–1868.

[3] On the Classification of Birds, Proc. Zool. Soc., 1867, pp. 415–472.

Of the Cecomorphæ, "the Procellariidæ are aberrant forms, inclining towards the Cormorants and Pelicans amongst the Desmognathæ" (*loc. cit.*, p. 458).

1871. G. R. Gray, in the Hand-list of Birds,[1] places the Procellariidæ between the Uriidæ and the Laridæ in his order Anseres. They are divided into three sub-families, corresponding to those already adopted by Bonaparte and Coues.

J. Reinhardt, in the same year, in his paper on the "Os crochu," or uncinate bone, in the skull of birds,[2] records its presence in nearly all the genera of this family that he has examined. In a note on p. 339 he corrects Professor Huxley's statement as to the usual absence of basipterygoid facets in the Petrels, such being only absent in the Albatrosses and Procellarinæ ("Stormsvalerne"), present in all the rest.

1872. Carl T. Sundevall[3] makes the Tubinares the fourth cohort of his order Natatores. He adopts the same three sub-families as Bonaparte, Coues, and Gray.

1873. Reinhardt describes[4] and figures two peculiar ossicles, of the nature of sesamoids, developed at the elbow-joint of these birds in the tendon of origin of the *extensor metacarpi radialis longior*. The existence of such an ossicle in the genus *Puffinus* had already been described by Meckel,[5] and Reinhardt finds two similar ones developed in the Albatrosses, as well as in the genera *Œstrelata*, *Puffinus*, *Majaqueus*, and *Adamastor* of the Procellariinæ. In *Œstrelata fuliginosa* and *bulweri*, *Diomedea*

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[1] *Loc. cit.*, vol. iii. p. 102.

[2] Om en hidtil ukjendt Knogle i Hovedskallen hos Turakoerne (*Musophagides*, Sundev.) med nogle Bemærkninger om de lignende Knogler hos andre Fuglefamilier; Videnskab. Medd. Naturh. For. Kjöbenhavn, 1871, pp. 326–341, pl. vii.

[3] Methodi naturalis avium disponendarum tentamen, Stockholm, 1872, pp. 140–143.

[4] Om Vingens anatomiske Bygning hos Stormfugle-Familien (Procellaridæ s. Tubinares), *l.c.*, 1873, pp. 123–138; also Gervais' Journal de Zoologie, vol. iii. pp. 139–144, 1874.

[5] Traité général, &c., vol. iii. p. 144, Paris, 1829.

chlororhyncha, and *Phœbetria fuliginosa*, he states that the smaller of these ossicles is wanting, though the larger is still developed. In a table he proposes the annexed classification of the Procellariinæ.

I. Wing-ossicles present. Twelve rectrices.
a. Puffineæ—
Œstrelata, Puffinus, Majaqueus, Adamastor.
II. Wing-ossicles absent.
First primary longest.
More than twelve rectrices.
b. Fulmareæ—
Ossifraga, Fulmarus, Daption.
Twelve rectrices.
Margin of beak without lamellæ.
Pagodroma.
Beak with lamellæ.
c. Prioneæ—
Halobæna, Prion.
Second primary longest.
d. Procellarieæ—
Procellaria, Oceanites.

A. H. Garrod, in the same year, shows[1] that the Petrels being "holorhinal" must be separated from the "schizorhinal" Laridæ and their allies. He further proposes[2] to divide the Petrels or Nasutæ into two groups, the "Storm-Petrels," with a formula AB.XY and no cæca, and the "Fulmaridæ," with formula AB.X and two short cæca. *Bulweria* alone has a formula A.X and is therefore quite different from the Storm-Petrels. In both groups the great pectoral muscle is double, as in many of the "Ciconiiformes," and there are two carotids.[3] The Nasutæ form the second cohort of his "Anseriformes," consisting of them and of the Anseres, which latter include the Anatidæ, Spheniscidæ, Colymbidæ, and Podicipitidæ.

1876. P. Pavesi, in his Studi anatomici sopra alcuni uccelli,[4] has given a few details on the visceral anatomy of *Diomedea exulans*, especially as regards the form of the stomach and the presence of spines on the laryngeal eminence, continuous laterally with a zone of similar papillæ developed round the commencing œsophagus.

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[1] Proc. Zool. Soc., 1873, p. 37; Collected Papers, p. 128.

[2] *Loc. cit.*, pp. 641, 642; 1874, p. 122; Collected Papers, pp. 204 and 220, 221. The passage on pp. 641, 642, describing the muscles of the Petrels, is unfortunately misprinted in the original paper. It is given in a corrected form, as altered by the writer, in the reprint of Professor Garrod's papers, p. 204. The two birds called in Garrod's text *Procellaria pelagica* (?) and *Procellaria fregata* (?), the "Storm-Petrels" on which his observations were based, were probably in reality *Oceanites oceanicus* and *Garrodia nereis* (*cf.* Proc. Zool. Soc., 1881, p. 736).

[3] *Loc. cit.*, 1873, p. 470; Collected Papers, p. 175.

[4] Ann. Mus. Civ. Gen., vol. ix. pp. 66–82.

1879. Dr. Hans Gadow, in his paper on the digestive organs of birds,[1] describes the alimentary viscera of the Tubinares, apparently based upon an examination of the four genera *Puffinus, Fulmarus, Procellaria,* and *Diomedea.* The arrangement of the intestinal folds is "orthocœlic," the intestine being disposed in eight folds lying close to and parallel with each other. In their orthocœlic character the Tubinares agree with the Steganopodes and Erodii, differing from the "cyclocœlic" Pelargi, Raptatores, and Laridæ.

1881. In a posthumous paper,[2] published in the "In Memoriam" volume of his works, the late Professor A. H. Garrod describes the anatomy of the Diving Petrel (*Pelecanoïdes urinatrix*), based upon an examination of specimens collected during the Challenger's voyage. *Pelecanoïdes* has no *ambiens* muscle, in which respect it differs from all the other true Petrels, and resembles *Bulweria* alone of them in its formula A.X. The main vein of the leg, the femoral vein, is superficial to, instead of deep of, the tendon of the femoro-caudal muscle, a peculiarity hitherto only observed in the genus *Dacelo* amongst the Kingfishers. "The Procellariidæ may be divided into the Storm-Petrels or Thalassidrominæ, and the true Petrels or Œstrelatinæ, the former differing from the latter in possessing the accessory semi-tendinosus muscle." These two groups therefore correspond to those already distinguished by Garrod in his former paper as the "Storm-Petrels" and the Fulmaridæ.

As regards the systematic position of the Petrels it is said—"I may mention that since writing my paper 'On Certain Muscles of Birds, and their value in classification,' I have changed my views as to the affinities of the Procellariidæ. In that communication I place the family amongst the Anseriformes ; now it is evident to me that it is with the Ciconiiformes that they are most intimately related. Reason for. my change of opinion will be found in what here follows." Unfortunately the paper was never completed, and the reasons mentioned not stated in consequence.

In a paper read before the Zoological Society on June 18th of the same year[3] I proposed to make the so-called *Procellaria nereis* of Gould, the *Procellaria fregata* of Professor Garrod's earlier papers, the type of a genus to be called *Garrodia,* it being not a true Petrel at all, but one of the allied group without cæca and with a formula AB.XY, the Thalassidrominæ of Garrod, which includes besides the genera *Oceanites, Fregetta,* and *Pelagodroma,* the family so formed constituting my Oceanitidæ.

1882. Lastly, in the concluding part of the Atlas to the great work on Madagascar,[4]

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[1] Versuch einer vergleichender Anatomie des Verdauungs-systemes der Vögel, Jen. Zeitschr. f. Naturw., Bd. xiii. (n.f. vi.), pp. 92–171, 339–403, pls. iv.–ix., xvi.

[2] 85. Notes on the Anatomy of *Pelecanoïdes* (*Puffinuria*) *urinatrix, loc. cit.,* pp. 521, 522.

[3] Proc. Zool. Soc., 1881, pp. 735, 736.

[4] Histoire physique, naturelle et politique de Madagascar, publiee par Alfred Grandidier, xv. ; Histoire naturelle des oiseaux, x. iv., Atlas iii., Paris, 1881. Plates 293, 294, 297, 298, 299, 300.

MM. Grandidier and A. Milne-Edwards have given figures of the skeletons and separate bones of *Prion vittatus*, *Puffinus chlororhynchus*, and *Thalassidroma oceanica*.

III. COMPARATIVE ANATOMY OF THE *TUBINARES*.

My object in working out the present report has been, not to produce a detailed description of the structure of any particular Petrel, but to describe the most important deviations from the ordinary avian type met with in this group, and to compare the members of it with each other, and with other groups of birds, in those points of their structure in which experience has shown birds to differ from each other.

Some of the modifications here described are of great physiological and morphological interest, whilst the numerous differences in points of detail displayed in the different sections and genera of the Tubinares lead one to expect that the future study of systematic ornithology will be not a little elucidated by the labours of the anatomist, wherever he, as in the present case, has material at his command sufficient for something like an adequate study of a natural group on the basis of structural differences more important than those that can be discerned from the superficial inspection of an ordinary skin.

In the present section the external characters, pterylosis, and visceral anatomy are first described; these are succeeded by an account of the myology, to which follows a description of the tracheal structures, and of certain other points in the anatomy of the soft parts. An account of the osteology concludes the whole.

1. External Characters and Pterylosis.

There are some points in the external characters of the Tubinares that may be noticed here, because in ordinary skins they can only be made out with difficulty, owing to changes and distortion in the process of drying.[1]

The order Tubinares derives its name from the character, prevalent throughout the group, of the external nares, which are prolonged into a more or less lengthy cylindrical tube, lying usually on the dorsal surface of the beak, and opening by one or two apertures (*cf.* figs. 1, 32, and 33, *infra*, pp. 12 and 59). The exact disposition and degree of development of these tubes vary in the different members of the group.

In the Oceanitidæ, and the smaller species of Procellariidæ (belonging to the genera *Procellaria*, *Cymochorea*, and *Halocyptena*), the nasal tubes quite coalesce, lying on the dorsal surface of the beak for about its basal half; the tube so formed rises rather abruptly from the forehead, and is truncated anteriorly, the single aperture so formed looking upwards and forward (*vide* Pl. I. figs. 1–5). In the Oceanitidæ (*e.g.*, fig. 8) the aperture viewed from in front is nearly circular, and with scarcely any appearance of a median septum. In the Procellarian genera, on the other hand (fig. 9), the aperture is more oval and distinctly double, owing to the median septum (formed by the coalesced inner walls of the narial tubes) being much less deeply, in a lateral view, excavated anteriorly, and so appearing to a greater extent superficially. The other Procellariinæ repeat this form of nostril, though the septum becomes much thicker, so that the nostrils open in them by two perfectly distinct apertures (*vide* fig. 7, where the nostrils of *Bulweria* are shown). They might thus be said to be "platyrrhine," in opposition to the "catarrhine" Oceanitidæ and other genera already mentioned. It is in *Bulweria* and *Majaqueus* perhaps, that the nasal septum is broadest and most superficial; in *Prion* it is well developed; in the remaining genera it is less near the external opening, but always quite evident. In the genus *Puffinus* the septum is also broad, but the narial tubes are so obliquely truncated that they hardly rise above the lateral outline of the beak; their openings are ovals, with their longer axis vertical or (*Puffinus obscurus*) oblique inwards.

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[1] I need not do more here than refer to the peculiar bill of the Tubinares,—the peculiarity arising from the subdivision, into more or less distinct plates, of the corneous covering of the mandibles,—as it is sufficiently described in systematic works on ornithology.

In *Pelecanoïdes* the nasal tubes are short and swollen externally; the septum is distinct, but not broad; and the apertures, which are sinuated ovals directed antero-posteriorly, look almost vertically upwards, their lateral outline being nearly parallel with the axis of the upper jaw.

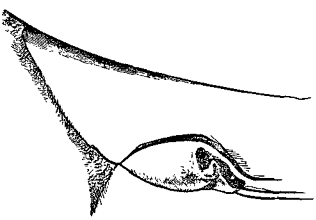

Fig. 1.—Base of Beak of *Diomedea exulans*, to show the form and position of the nostril.

In the Diomedeinæ the nasal tubes are quite separate from each other, lying just at the lower margin of the "culminicorn." They are usually described as tubes with a distinct circular complete aperture, but on looking at this carefully, there may be seen (*vide* fig. 1) in front and below this tubular opening a deep cavity leading backwards and continuous behind, over the edge of the apparent outer boundary of the aperture, with the general cavity of the tube, an infolding of the outer wall of the latter forming the apparent outer wall of the tubular aperture.

The nasal tubes of the Petrels are formed, it may be observed, by the elongation of the cartilaginous walls of the nasal capsules. The upper and lower turbinal cartilages are well developed; the alinasal turbinal cartilage, on the other hand, is represented only by a slight ingrowth from the internal nasal wall. Such, at least, is the condition of these parts in *Majaqueus*, the only form I have examined as regards these structures.

The legs are always bare of feathers for some little distance above the tarsal joint, the metatarsal scutellation extending upwards over the joint some little way, but disappearing where the leg is covered by the feathers, and there replaced by simple skin.

The scutellation of the tarsi presents different characters in the Procellariidæ and Oceanitidæ respectively. In the former, in all the forms, the legs, which are often much compressed below the lower limit of feathering, are covered pretty uniformly by small scutellæ of hexagonal shape (*vide* Pl. I. fig. 5, *a*). In the Oceanitidæ, on the other hand, though the back and more or less of the lateral aspects of the leg are so covered, the front of the leg is either, as in the genera *Oceanites* (Pl. I. fig. 1, *a*) and *Fregetta* (Pl. I. fig. 4, *a*), "ocreate," being covered for nearly all its length by a single long scute, or, as in *Garrodia* and *Pelagodroma* (figs. 2, *a*; 3, *a*), has a series of strong, well-marked, obliquely transverse scutellæ, extending on to the external and internal faces of the leg for some distance.

The hallux in the Tubinares is always extremely small, and in the genus *Pelecanoïdes* quite absent. When present it consists only of a single joint (*vide infra*, p. 53, and Pl. VI. fig. 14), which, even when best developed, is very small and covered by a short, nearly straight, spur-like claw, which projects externally, some little way above the level of the other digits, and, being very small, may easily be passed over. In the Oceanitidæ this nail is extremely minute, considerably more so than in the Procellariidæ of similar size, but is always present[1] and very straight and spur-like. In most of the Procellariidæ it is larger and more curved: it is best developed proportionately, perhaps, in *Pagodroma*.

In the Albatrosses the hind-toe is so minute that these birds are usually described as being three-toed, but this is not really quite correct. In *Phœbetria* the hallux externally only just appears, being represented merely by a slight pimple-like elevation, with a very minute claw. On dissecting away the skin, the pimple is seen to be connected with two minute bony nodules, the basal one, which represents the metatarsal, more globular, the apical one more pointed and covered by the minute claw. They are only connected by connective and fibrous tissue to the tarso-metatarsus,[2] and are separated from each other by a considerable interspace, the whole having a total extent of only 3 mm. (*vide* fig. 2, *a*).

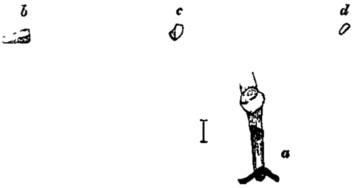

FIG. 2.—Rudimentary Hallux of the Albatrosses, of the natural size, except *a*.

a. *Phœbetria fuliginosa*, showing the two ossicles, connected together by fibrous tissue, the distal one being covered by a minute claw, which appears outside the skin (represented in section).

b. *Diomedea exulans*.

c. *Diomedea brachyura*.

d. *Thalassiarche culminata*.

In *Thalassiarche* (*culminata*) and *Diomedea* (*brachyura* and *exulans*) this hallux is still more rudimentary, and there is not a trace of a nail outside. Still, on careful inspection, there is a slight elevation visible on the area usually occupied by the hallux, and on dissecting away the skin a single minute ossicle, of triangular shape, is to be found attached to the tarso-metatarsus and surrounding structures by fibrous tissue. This single bone probably represents the metatarsal element. In *Diomedea exulans* it has a length of 0·2 inch (5 mm.); in the other two species, particularly in *Thalassiarche*, it is much smaller, not exceeding here 2 mm. in length (*vide* figs. *b–d*). I have been unable to find it at all in *Pelecanoïdes*, even in quite young birds.

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[1] Mr. Dresser erroneously describes it as wanting in *Oceanites* (Birds of Europe, vol. viii. p. 503).

[2] The existence of the rudimentary hallux in *Phœbetria fuliginosa* was first, I believe, pointed out by Dr. Kidder in his account of the birds of Kerguelen's Land, Bull. U. S. Nat. Mus., vol. i. p. 22.

The anterior three toes are well developed, and are completely webbed, the web however not extending to the hallux. The claws are well developed; in the Procellariidæ they are always more or less curved, compressed, and sharp-pointed (*vide* Pl. I. fig. 5, *b*, *Procellaria pelagica*), whilst in the Oceanitidæ they become lamellar, depressed and flattened, a shape that attains its maximum in the genus *Fregetta* (*vide* figs. 1–4, *b*). Hence an inspection of the legs alone of a Petrel will show, by the character of the tarsal scutellation and the form of the claws, whether it is one of the Oceanitidæ or of the Procellariidæ.

Pterylosis.—The pterylosis of this group seems to be, on the whole, very uniform throughout, both in the form of the tracts and the structure of the feathers.

The number of rectrices and remiges is not absolutely constant however, and there are also some slight differences in the form of the dorsal and lumbar tracts.

As regards the number of rectrices in the Tubinares, twelve is the ordinary number in both families, and this is never reduced,[1] and only in a few instances exceeded. *Fulmarus* and *Daption* have fourteen tail feathers, as already pointed out by Nitzsch, and the same is the case in *Thalassœca; Ossifraga* has as many as sixteen. *Aeipetes antarcticus* (in both the specimens examined by me) has, on the other hand, unlike *Thalassœca*, the normal number of twelve.

The number of primary remiges is always ten, but that of the secondaries varies. The number of these in the Oceanitidæ is always ten: in the Procellariidæ it is never, even in the smallest forms (*Pelecanoïdes, Cymochorea, Halocyptena, Procellaria*), less than thirteen. *Bulweria* has twenty, which is about the average number throughout the group, increasing however in the larger forms to twenty-nine (*Ossifraga, Thalassiarche*), thirty (*Diomedea brachyura*), and even, in the largest of all, *Diomedea exulans*, to thirty-seven.[2] The pollex never has the claw so often present in birds on that digit.

As regards the distribution of the tracts of contour feathers, I may quote Nitzsch's general description (Pterylography, Ray. Soc. Ed., pp. 143, 144):—"In this family the tract-formation of *Lestris* is elevated into the type of a group, undergoing scarcely any change in the form of the inferior tract, but showing some little modification in the dorsal tract. We find, therefore, on the head a uniformly dense plumage, from which the two principal tracts issue. The latter are separated from each other by the two lateral neck-spaces, which extend high up, nearly to the head. The inferior tract is divided near the head, becomes of considerable breadth whilst still on the neck, and passes in this condition on to the breast, the surface of which is covered by each band in a rather broad, parallel-sided form, emitting no branch as far as the margin of the *musculus pectoralis major*. Here it is divided by a space starting from the knee-covert in such a manner that a short continuation of the tract, which is to be regarded as an outer branch, passes near the knee into the lateral space of the trunk, runs on over the thigh, and soon afterwards terminates. The other, inner branch, which represents the main band, then proceeds on the belly, turns in a somewhat arcuated form outwards, dilates considerably in the middle of the bow, and terminates near the anus. . . . The dorsal tract is at first broad, becomes narrower towards the middle of the neck, then expands at the shoulder, and divides at that point, or from the middle of the scapulæ, into two limbs. In most of the Tubinares these limbs pass uninterruptedly into the posterior half of the dorsal tract; and this circumstance forms their family character as distinguished from the Longipennes. In the present group the posterior half of the dorsal tract encloses a longitudinal space as far as the caudal pit, dilates a little outwardly on the pelvis, and thus usually becomes united with the very oblique lumbar tracts, and grows rather strong in the simple uropygial band, also covering the base of the oil-gland."

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[1] Nitzsch (Pterylogr. Ray Soc. Ed., p. 141) thought that the smaller species of Petrels had but ten tail feathers, but such is not in reality the case.

[2] Nitzsch even describes the species as having as many as forty secondaries. The total alar expanse of the specimen I counted this number in was 9 feet 7¾ inch.

Nitzsch had no opportunity of examining the pterylosis of *Pelecanoïdes*, nor any of the Oceanitidæ. His remarks were based on examination of *Fulmarus glacialis*, *Daption capensis*, *Ossifraga gigantea*, *Procellaria pelagica*, *Halobæna cærulea*, *Puffinus obscurus*, and *Diomedea exulans* and *chlororhyncha*. Nitzsch points out certain peculiarities in the latter genus, the most important of these being the division of the dorsal tract into two quite separate parts—an anterior stronger part, ending in an interscapular fork, and a posterior, weaker, dilated part. The lumbar tracts he describes as weak and uniserial. I find this division of the dorsal tract to hold good in *Diomedea exulans* and *brachyura*, as well as in *Thalassiarche culminata*, though the break is not very obvious, and chiefly marked by the difference in strength of the feathers. In a nestling of *Phœbetria*, however, there is no such break apparent; though the dorsal tract anteriorly is stronger, it passes behind into the posterior part, and the same condition, as is pointed out by Nitzsch, obtains in *Ossifraga*. The lumbar tracts also can hardly be strictly described as uniserial, as they tend to coalesce, by rows of interposed contour-feathers, with the external borders of the dorsal tract, no very obvious demarcation separating the two.

Pelecanoïdes and the Oceanitidæ quite conform to the general type of the group, and indeed the only at all obvious difference in this, beyond those already mentioned, lies in the greater or less amount of the connection between the lumbar and dorsal tracts, this being almost *nil* in *Cymochorea* and *Procellaria*, and considerable in the larger forms, *Majaqueus*, *Puffinus*, &c. The knee-gap may become so deep as to completely divide the inferior tract into two parts below (*e.g.*, *Pelagodroma*, *Prion*, and, according to Nitzsch, *Halobæna*).[1]

The hypopterum is usually well-developed, with long feathers, and the humeral tracts are very strong and broad.

The contour-feathers always have an after-shaft, though in the Diomedeinæ it is extremely small, most so in *Diomedea exulans* where it is reduced to a short tuft, about half an inch long, of five or six nearly simple, straight plumes. In the smaller Albatrosses it is larger, and in the rest of the group, including *Pelecanoïdes*, it is of good size.

All the forms have their spaces as well as tracts covered by down-feathers, which may become very long and close-set, especially in *Pagodroma*.

The oil-gland is always large, globular, with its surface covered above at the base—which is also partly covered by the termination of the uropygial band of the dorsal tract—by scattered semi-plumes, and with a tubular mamilla, provided with a good tuft of down-feathers. The tuft and gland are never absent. In the Oceanitidæ and smaller forms (*Cymochorea*, &c.) the tuft of feathers simply encircles the apex of the gland, but in the larger ones it sends a median prolongation across it as well, so as to divide the surface of the mamilla into two lateral parts, separated from each other by the median row of feathers, and each with its opening or openings. The number of these varies in the different forms of the group, as already indicated by Nitzsch (*loc. cit.*, p. 144). *Diomedea exulans* has about half a dozen small ones in each half, arranged in a crescent. *Diomedea brachyura* and *Thalassiarche* have numerous small apertures opening into a single large circular common opening. The Fulmars, except *Aeipetes*, have several apertures in each half, as have *Daption* and *Pagodroma*, *Ossifraga* having as many as five. *Majaqueus* has four; *Œstrelata* three. *Aeipetes*, *Pelecanoïdes*, *Bulweria*, and the smaller Procellariidæ, as well as the Oceanitidæ, have apparently only two pores, one in each half of the gland.

The very young birds, I may remark, are, in all the species I have seen, covered with a thick coating of fluffy grey down, which is pushed off as usual at the ends of the contour-feathers when the latter appear. There are apparently no intermediate changes of plumage, the first plumage of the young bird being similar to that of the adult,[2] a condition of things very unlike that in the Gulls (Laridæ) with which the Tubinares have so often been associated. Besides the long down on the tracts corresponding to the future tracts of contour-feathers, the young birds have a shorter downy covering distributed pretty uniformly, as in the adults, over the intervening spaces, and between the feathers of the tracts.

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[1] Nitzsch lays some stress on the angle, whether acute or obtuse, made by the lumbar tracts at their junction with the dorsal; but the difference in the direction of the two parts is not, as seen in entire birds, so obvious as would be judged from Nitzsch's figures (*loc. cit.*, pl. x. figs. 2, 3), which were probably made up from the examination of skins only. The lumbar tracts, where the connecting rows of feathers are best developed, seem always to run outwards and backwards from the dorsal tracts, as shown in his figure of *Puffinus obscurus*.

[2] *Diomedea exulans* may be an exception.

2. Alimentary Canal and its Appendages.

The Tubinares as a group agree very closely together in the form of stomach and intestines possessed by them, which have peculiarities not occurring in any other groups of birds, and it is only in the variations in form and structure of the tongue, in the nature of the armature of the mucous membrane of the mouth, and in the presence or absence of cæca that the various forms differ in any important degree from each other.

The mucous membrane of the palate usually presents, in the Tubinares, several series of longitudinal rows of pointed, retroverted papillæ, which no doubt serve in the capture and retention of the prey by these birds. The most ordinary arrangement of these may be understood from Plate II. fig. 21, where the palate of *Œstrelata lessoni* is represented.

The palate is cleft for about half its length by a narrow median fissure, fringed on each side by a row of small spines, which dilates behind into the opening of the posterior nares, which is similarly fringed. Behind this, separated by a small interval, is the linear median aperture of the Eustachian tubes. From the anterior extremity of the median fissure runs forwards, to near the end of the beak, a sharp median ridge, with four or five strong, conical spines developed on it posteriorly. This ridge is separated by a deep groove on each side from the margins of the beak. Along a line corresponding to that of the palatine bones, and extending for an extent equal to that of the median fissure, there is developed on each side a second longitudinal row of retroverted and pointed spines, much longer and stronger than the more median series. In front of the posterior-narial aperture there runs between the two longitudinal series an oblique series of smaller spines, whilst behind the Eustachian aperture is a second transverse series, concave anteriorly.

In all the species of the genera *Œstrelata*, *Bulwerla*, and *Majaqueus* examined by me the same condition obtains, the larger species, however, as that figured, frequently developing one or two rows of smaller spines lying parallel to the external longitudinal row, one outside, and the other between it and the median fissure. *Puffinus* is similar, but the anterior median keel is smooth, and almost without spines, and the palate to the sides of the Eustachian aperture becomes covered with small spines.

In *Cymochorea* and *Procellaria*, as in *Halocyptena*, the palate is much as in *Œstrelata*, but with all the spines smaller and feebler, particularly those on the palatal ridge. In the first genus at least the prenarial ridge is nearly smooth, and between the palatine row of spines—only developed posteriorly—and the median a stronger row is developed, so that there are here altogether three pairs of longitudinal spines above.

In the Oceanitidæ the palate is much the same, but the palatine row becomes very weak and nearly obsolete, whilst the intermediate row is the strongest, considerably, of all.

The prenarial ridge may be slightly toothed or nearly smooth: it always ends, however, at the commencement of the median fissure, in a slightly raised prominence, divided into two lateral parts, in a way not seen amongst the Procellariidæ. (*Vide* Pl. II. fig. 19, giving an enlarged view of the palate of *Oceanites oceanicus.*)

Pagodroma resembles *Œstrelata*, but all the spines have become much smaller and weaker, and this is still more the case in *Daption*, where they have almost entirely disappeared save round the posterior nares. The line of the interior margins of the premaxillæ and of the palatines is marked by a distinct raised ridge, and the edges of the upper mandible, from the angle of the mouth as far forwards as the dertrum, are marked by a series of slight, closely-set, raised ridges, oblique forwards and outwards. It is by a great development of these that the peculiar fringed bill of the genus *Prion*, reminding one of that of a duck, is produced. In *Prion* (*t.c.*, fig. 23, *Prion banksii*) the palate is almost smooth throughout, with the exception of a distinct prenarial ridge, and some indications of the palatine series of spines posteriorly (not represented in the figure): the median fissure and narial opening are however, as usual, bounded by small spines. From a point corresponding to the angle of the mouth forwards to a little behind where the dertrum forms the cutting edge of the bill, the margins of the mouth are bounded by a well-developed fringe of closely-set lamellæ, reminding one much of the plates of a whale's baleen. These lamellæ are developed from the mucous membrane of the mouth, and are probably entirely epidermic in origin; in the cleaned skull there is no trace of their presence (*vide* Pl. VI. fig. 4). They are best developed a little way in front of their posterior termination of the fringe; here the lamellæ are nearly vertical thin plates, set on at right angles to the axis of the beak, but curved both forwards and outwards. Anteriorly they become more oblique forwards, and much shorter. Outside of them the cutting edge of the beak is produced downwards for a little way, so that a groove is formed between the beak and the pectinated fringe.

When the lower bill is in position, the more posterior and strongest of the lamellæ completely occupy the slight space left between the cutting edge of the two jaws, lying with their free ends curved outwards in a slight groove outside the lower mandible formed by the reflection from it of the feather-covered skin. Anteriorly this groove disappears, and the fringe simply lies against the outer surface—which is quite smooth, and not, like that of the duck or flamingo, correspondingly grooved for the reception of the lamellæ of the fringe—of the lower jaw, which in front it does not even reach. In the larger-billed *Prion vittatus* these lamellæ are even more developed, whilst in the smaller-billed *Prion desolatus* they are less so: *Prion banksi* is so completely intermediate in this respect that I see no reason for the adoption of Dr. Coues' genus *Pseudoprion*.[1] The only other

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[1] Proc. Ac. Nat. Sci. Phil., 1866, p. 164, where that writer has also described the structure of these fringes at length.

Petrel in which the beak is fringed in a way similiar to that here described is *Halobæna cærulea*, of which, however, as yet I have been unable to examine more than skins.

The existence of a peculiar fringe of lamellæ along the margin of the mouth has often been insisted on as an argument for placing *Phœnicopterus* amongst the Lamellirostres, but the development of, at least, a very similar arrangement in *Prion* and *Halobæna*, birds of a very different group again, ought to show that an adaptive contrivance of this kind may be, apparently, independently developed without great difficulty and yet with many features of common resemblance, in different birds without necessitating any immediate genetic connection between its possessors.

In *Fulmarus* (Pl. II. fig. 22) a rudimentary fringe of the upper mandible is present, a little more developed than in *Daption;* in other respects it conforms to the type of *Œstrelata*, the spines, however, being very small and rudimentary. *Ossifraga* is similar in all essential points, but the palate is longer, and, at least in young birds, more spinulose. In *Aeipetes* and *Thalassæca* the pectination of the mandible can only just be traced; the palate is much longer and narrower in shape than in *Fulmarus*, the spines smaller, and the palatine ridges better marked.

In *Pelecanoïdes* (Pl. II. fig. 20) the palate is quite smooth throughout, with no ridges or spines, except on the area round the posterior nares, which is pretty uniformly covered with sharp elongated spines of fair size.

In the Diomedeinæ the palate is comparatively smooth. There is a long prenarial ridge, only with slight indications of spines at its most posterior part. The spines bounding the narial and Eustachian apertures are well-marked, those on the palate small and best developed towards the posterior end of the prominent palatine ridges. Between the latter and the median fissure are developed, especially in *Diomedea exulans*, additional spines of small size, as well as a short row outside their most posterior part. Outside the tongue, between it and the inner margin of the jaws, the mucous membrane of the floor of the mouth has on each side a well developed series of stronger spines.

The tongue, as may be seen by a glance at Plate II., where the chief variations of its form are represented, is by no means constant in shape in the Tubinares.

In the Oceanitidæ, (*vide* fig. 5, *Oceanites*), and the genera *Cymochorea* (fig. 9), *Procellaria*, and *Halocyptena* of the Procellariidæ, the tongue is of triangular shape, fairly fleshy basally, but tapering and becoming thinner anteriorly, its extremity being pointed and more or less membranous, so as to easily be destroyed by rough usage. Its posterior margin, or base, is somewhat concave, and fringed by a row of small retroverted pointed papillæ. This is the form of tongue found, more or less modified, through the entire group.

In *Œstrelata* (fig. 15),[1] *Majaqueus*, *Bulweria*, and *Puffinus obscurus* the tongue becomes more fleshy, and slightly grooved above, especially anteriorly. The sides moreover are edged by a series of large triangular backwardly directed papillæ, extending forwards for about the back half of the length of the tongue, but in *Puffinus* to nearly its apex. In *Puffinus brevicauda* (fig. 18) there are, in addition, four longitudinal fairly regular rows of such papillæ developed on its dorsal surface, those nearest the middle line being the biggest.

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[1] I have figured (fig. 16) on Plate II. a tongue of different form from any other known to me as occurring in the group of Petrels. It has been labelled "*Œstrelata brevirostris*," but does not agree with the other species of that genus

In the species of the genus *Diomedea* (fig. 7) the tongue is also similarly covered above, pretty uniformly, with spines, best developed on the dorsum a little behind the apex of the organ, but is much shorter in form, being of an elongated cordate shape. In *Phœbetria* (fig. 8), on the other hand, the tongue is much more pointed and elongated, being free for about its apical two-thirds, and with the dorsal surface glabrous, the spines being confined to its basal margin. In a nestling of this species the tongue has much the same shape, but is covered for the greater part of its extent above by spines, as in *Diomedea:* these must therefore disappear as the bird reaches maturity. In *Thalassiarche* the tongue is somewhat intermediate in shape, though most resembling that of *Phœbetria. Pagodroma* (fig. 14) has a very elongated, tapering tongue, with its base and lateral margins for about their posterior quarter spinulose. The tongue of *Daption* (fig. 12) is much broader and more fleshy; the spines are small, and almost confined to its base, with only a few very obsolete ones towards the posterior angles laterally. It is only free for a little more than a quarter of its length. *Prion* (fig. 13) is similar, but the tongue is more fleshy, and the spines are smaller and quite confined to the base: the apex is also only free for a very small extent. In *Prion vittatus* the tongue becomes extremely large and fleshy, occupying the whole of the wide space between the rami of the mandible. *Aeipetes antarcticus* (fig. 11) has a tongue very like that of *Pagodroma,* but of course larger and less elongate: that of *Thalassœca glacialoides* is very similar, but longer a little than that of *Aeipetes.* In all these forms the tip is blunt or emarginate, with a slight dorsal groove apically. *Fulmarus* has a more fleshy tongue of the same type, with a distinctly emarginate end, and a more evident groove, extending for two-fifths of its length.

In *Ossifraga gigantea* (fig. 10) the tongue is very elongated,—three inches long,—and narrow proportionally. Its apex is slightly emarginate, and there is a deep groove for about two-fifths of its length, and traceable further back to the base of the tongue. The base has a fringe of pointed spines, which are continued, of smaller size, along the lateral margin for some way, there being some very much smaller spines developed inside them on the borders of the tongue for about an inch, though not reaching the posterior angles of the organ by half that extent.

(*lessoni* and *mollis*) examined by me nor with any of my young specimens of the so-called *Œstrelata brevirostris,* these resembling rather the species just named. This tongue is remarkable for having no spines laterally, those of the base being well developed, and for its narrow and deeply grooved form and slightly emarginate tip. In spite of its label, it belongs, I strongly suspect, to some species of the Laridæ.

In *Pelecanoïdes* (fig. 6) the tongue is fleshy, and fairly parallel-sided, tapering apically. It is but little free, and occupies most of the interspace between the mandibular rami. Its base is notched, and provided with some largish spines, which continue forwards for about the basal half, or more, of the lateral margins. On the dorsal surface there is alway a peculiar lanceolate mark, apparently due to a difference in the nature of the mucous membrane covering the tongue over this area.

The œsophagus—which in the Albatrosses, as already described by Pavesi, may be surrounded at its commencement with a zone of spines, continuous below with the spines covering the laryngeal eminence—is always capacious and distensile, but possesses no crop. Inferiorly, in the thorax, it passes without any marked constriction or other difference into an enormous proventriculus, which is a thin-walled bag, reaching down nearly to the posterior extremity of the abdominal cavity, which it largely occupies, lying to the left side of the stomach proper and the mass of the intestines. This great proventricular bag is twisted back on itself apically, and then, becoming slightly narrower, passes by a small aperture into the stomach proper or gizzard. This aperture is therefore to the right of, and anterior to, the great "fundus," which lies freely in the posterior part of the abdominal cavity, covering there the terminal portion of the intestine and cloaca. Internally, the proventricular glands are seen to cover pretty uniformly the whole surface of the mucous membrane, with the exception of a more or less narrow zone, which lies between this glandular part and the stomach proper, corresponding pretty nearly to the narrower, ascending part of the bag as seen from outside (*vide* Pl. II. figs. 1 and 2). The extent of this very deep "zonary" proventriculus (*pr.*) is always very considerable in the Petrels, being of course, *cæteris paribus*, larger in the larger than in the smaller species. In *Majaqueus* its extent is 4·0 inches; in *Pelecanoïdes*, 1·85 inches: in *Fregetta grallaria*, 1·2 inches.

The stomach proper (*g.*) is always small and more or less globular, with fairly muscular walls and provided with the usual central tendinous sheets, so that it may fairly be called a gizzard. Its situation is peculiar, lying always above and to the right of the proventricular fundus, and with its pyloric part so flexed on itself that it looks backwards instead of forwards as in all ordinary birds (*vide* Pl. II. figs 1, 2), in this respect somewhat resembling the stomach of *Struthio*. In *Struthio*, however, the pyloric aperture is on the deep (dorsal) side of the stomach, nearly in the middle line, and so concealed when the viscera are viewed from the abdominal aspect. In the Tubinares the pyloric aperture, on the other hand, is quite superficial, lying at the inferior (posterior) end of the gizzard in the angle formed by the two parts of the bent proventriculus.

The gizzard, which is nearly always found full of the horny beaks of *Cephalopoda*, is lined internally by an "epithelium," which is usually dark in colour, and frequently of almost corneous texture, with a more or less corrugated or wrinkled free surface (*vide* Pl. II. fig. 4, where the epithelial lining of the everted gizzard of *Fulmarus* *glacialis* is represented[1]). In the Oceanitidæ and Diomedeinæ this epithelium is softer; its character in other Petrels is but an exaggeration or reproduction of that existing in some other birds, particularly that occurring in such storks as *Xenorhynchus.*

The displacement of the pyloric orifice of the gizzard to the left necessitates a corresponding change in the commencing duodenum, so that this at first ascends in an upward curve towards the right before it returns to form the backwardly-directed loop, characteristic of Aves and Mammalia, round the pancreas (Pl. II. fig. 1, *p.*).

This peculiar upward curve of the commencing duodenum, the singularly small inverted stomach, and enormously deep proventriculus are all peculiar, so far as I am aware, to the group of Tubinares, though universal amongst them, and no other bird yet examined has, so far as I know, a similar disposition of these viscera.[2]

The intestinal cæca are entirely absent in all the Oceanitidæ, but are, with one exception, present, though of small size, in the Procellariidæ. They are always short and globular, and closely connected to the intestine, so as to appear as mere nipple-like projections from it. Plate II. fig. 3 represents those of *Majaqueus* slightly enlarged. They are usually situated quite close to the cloaca, the large intestine in nearly all the Tubinares being quite short; the length of the cæca themselves rarely exceeds ·25 inch, except in the very largest species (*vide* table, p. 23). In five specimens (one a nestling) of *Cymochorea leucorrhoa* that I have examined, I find only a solitary cæcum, lateral in position, developed, owing apparently to the abortion of its fellow. As Mr. Swinhoe in his description of *Cymochorea monorhis*[3] also records the cæcum as single, it is probable that the existence of such a single cæcum is a character of the genus *Cymochorea.* It is not unusual, I may observe, in a group of birds in which the cæca are of small size, and probably of no physiological importance, to find specimens or species with the normal number of cæca reduced by one. I may give as instances *Mergus albellus* (*cf.* Hunter, Observ., vol. ii. p. 325; and Garrod, Coll. Papers, p. 220) amongst the Anseres, and *Plotus anhinga* (Garrod, *l.c.*, p. 345) amongst the Steganopodes, not to mention all the Ardeidæ amongst the Herodiones. In *Halocyptena*, in the only specimen yet examined, I could find no trace of any cæca at all, so that the tendency to their disappearance already observable in

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[1] The figure of Carus and Otto (Tabulæ Anat. Comp. Illustr., part 4, t. vi. figs. 15, 16) of the epithelium of the gizzard of *Fulmarus glacialis* does not at all faithfully represent what I have seen in two (quite fresh) specimens of that bird, nor have I ever in other Petrels seen epithelium of such a corneous and pavement-like nature as that figured by them. I have, therefore, had one of my specimens carefully drawn of the natural size. In this place it will be well to recall the still more highly developed gastric epithelium of some of the Fruit-pigeons (*Phænorhina goliath* and *Carpophaga latrans*) described by Verreaux and Des Murs, Viallanes and Garrod (*vide antea*, Report on the Birds, pp. 152–154).

[2] The description of these parts in the Little Auk (*Alca alle*) given by Professor Owen (Anat. Vert., vol. ii. p. 163), and originally due to Home (Lect. Comp. Anatomy, i. pp. 283, 284, 1814) does not all apply to that bird (*cf.* the figure and description given by Macgillivray in Audubon's Ornithogical Biography, iv. pp. 306–309), and probably refers to some member of the Tubinares.

[3] Ibis, 1867, p. 387. I have examined the type of this species, which is now in Mr. Seebohm's collection, and find it to be a true *Cymochorea.*

Cymochorea seems here to have progressed further still. The intestines are not capacious, but the commencing duodenum may be slightly dilated.

The following are intestinal measurements:—

	Small Intestine.	Large Intestine.	Cæca.	Total length of Intestine.
Oceanites oceanicus,	...	...	—	10·0
Garrodia nereis,	...	...	—	8·5
Fregetta grallaria,	...	...	—	13·0
,, *melanogastra*,	...	...	—	8·0
Pelagodroma marina,	...	...	—	12·2
Procellaria pelagica,	8·0	1·0	·075	...
Cymochorea leucorrhoa,	9·9	·6	·1	...
Prion desolatus,	19·5	...	...	...
,, *banksi*,	17·0	·25	·2	...
Daption capensis,	33·0	1·4	(?)	...
Thalassœca glacialoides,	48·25	1·4	·2	...
Aeipetes antarcticus,	50·2	1·2	·3	...
Ossifraga gigantea,	94·0	2·0	·5	...
Fulmarus glacialis,	53·5	1·5	·25	...
Puffinus obscurus,	17·0	·5	·2	...
,, *anglorum*,	23·0	1·0	·2	...
,, *brevicauda*,	24·0	1·25	·25	...
Majaqueus æquinoctialis,	54·4	1·75	·25	...
Œstrelata lessoni,	42·0	...	·25	...
Bulweria columbina,	—	—	·25	12·0
Pelecanoïdes urinatrix (a),	16·25	...	·2	...
,, ,, (b),	15·0	1·5	·2	...
Diomedea exulans,	121·4	4·0	·8	...
,, *brachyura*,	89·0	2·0	·3	...

The liver is usually about equilobed, the lobes not being large, and rather triangular in shape. In the Albatrosses, however, the right lobe becomes elongated and distinctly bigger. The gall-bladder, developed on the right hepatic duct, is always present so far as my observations extend. The hepatic ducts (Pl. II. fig. 1, *r.h.d.*, *l.h.d.*) open close together into the ascending arm of the duodenal loop, close to the pancreatic ones, of which there are usually two or three in *Majaqueus*. In the specimen of *Thalassœca glacialoides* dissected the left hepatic duct divided, soon after leaving the liver, into two branches, each of which opened separately into the duodenum, so that altogether this received three ducts from the liver. The vitelline rudiment is not to be found in the adult birds. The *bursa fabricii*, in young birds at least, is a well-developed large sac, with thick glandular walls, and a small opening into the cloaca. The spleen is circular, or nearly so.

3. Myology.

The myology of the Tubinares presents many features of interest, as will be seen from the following description. The species of the group, broadly speaking, resemble each other very much in the details of their muscular structure, though in the fore-limb the structure of the *biceps* and the termination of the *tensor patagii* tendons, and in the hind-limb the presence or absence of the *ambiens* and the accessories to the femoro-caudal and *semi-tendinosus*, present characters available for taxonomic purposes.

Anterior Extremity.

Pectoralis primus.—This muscle is always largely developed in the Tubinares, as might have been expected from their great powers of flight. It is peculiar in that it is always *easily divisible into two quite separate layers* superimposed on each other, besides which it gives off thin fan-like cutaneous branches. A similar disposition of the *pectoralis primus* in two distinct layers is very characteristic of many of the Ciconiiform birds of Garrod, occurring in all the Storks and Cathartidæ, and in *Phaëthon, Fregata, Plotus, Sula,* and *Pelecanus* amongst the Steganopodes. A tendency to a similar condition, though the two layers are only separable with difficulty, may be seen in the Ardeidæ, Falconidæ, and *Scopus.*

The *superficial* layer of the *pectoralis primus* arises (*vide* Pl. III. figs. 1 and 2, *p.* 1*a*) from the posterior and lateral margins of the body of the sternum, from the margin of the sternal *carina,* and from the inferior border and external surface of the clavicles. In the latter position it is divisible into two layers, one arising from the extreme margin, the other and deeper from the surface, of those bones. The common insertion into the large humeral crest is very tendinous behind, more fleshy anteriorly, these two parts being somewhat divided by the thick tendon of the deep layer of the muscle (*vide* Pl. III. fig. 1, *p.* 1*a*).

The *deep* layer of the *pectoralis primus* arises chiefly from the body and keel of the sternum outside the origin of the *pectoralis secundus,*—from which it is separated by a strong fascia,—from the tip of the furcula, and from the fascia over the second pectoral, especially anteriorly, where a large air-space separates these two muscles in the interval between the furcula and coracoid (Pl. III. figs. 1 and 2, *p.* 1*b*). Its tendon is thin anteriorly, strong and cylindrical posteriorly, and is inserted, as already described, between the two parts of the tendon of the superficial layer which arches over it.

The muscle is perforated a little anteriorly to its posterior border, and in front of the strong tendinous band dividing it, by a group of vessels and nerves destined for the supply of the muscles and skin incumbent on it. The most posterior of its fibres do not apparently join the main tendon of insertion, but are lost in the loose fibrous tissue occupying the axillary region.

There is a large cutaneous branch given off by the superficial layer close to its insertion, which runs back over the humerus, and is distributed as a fan-shaped expansion to the outer branch of the pectoral tract. Another cutaneous branch comes off from the anterior end of the muscle on the breast close to the *symphysis furculæ*, and goes to the skin of the lower and anterior aspect of the neck.

Pectoralis secundus.—This muscle is also well developed, but though broad is usually short, extending for not more than one-third, one-half, or sometimes two-thirds the length of the sternum. In *Pelecanoïdes*, however, it is much longer, extending to nearly the end of that bone, and in *Procellaria, Garrodia, Fregetta,* and *Pelagodroma* its extent is nearly as large, in which cases it extends beyond the posterior margin of the deep layer of the first pectoral.

It arises from the antero-superior part of the *carina sterni*, and from the body of the bone external to that, from the greater part of the coraco-furcular membrane below the *pectoralis tertius*, from the *symphysis furculæ*, and from a greater or less extent of the antero-inferior border of the coracoid bone. Its insertion is by the usual tendon on the superior aspect of the humerus, behind the much smaller tendon of the third pectoral.

In the Albatrosses the *pectoralis secundus* is unusually short, and broken up into four quite separate parts, which unite before passing the shoulder-pulley. This arrangement is clearly shown in fig. 2 of Plate III. representing the muscle in *Diomedea brachyura.* In the other Petrels, the muscle is much more homogeneous, and only separable by dissection into its various component parts.

Pectoralis tertius.—This muscle (Pl. III. fig. 2, *p.* 3) is always well developed in the Tubinares, in the form of a broad, thin band, more or less parallel with the coracoid, occupying the superior half of the broad space between that bone and the furcula, its fibres arising chiefly from the strong membrane between these bones, sometimes with additions from the anterior margin of the coracoid, or from the body of the sternum close to the middle line.

Tensor patagii brevis and longus.—These muscles have always a common, rather thin and flat fleshy belly, arising from the extreme upper end of the clavicle, and receiving, in addition, special small slips from the surface of the great pectoral. From this fleshy belly spring two tendons, of which one always forms the marginal patagial tendon, and must therefore be considered as the *tensor patagii longus.* Both the tendons are connected, close to their origin, by fibrous slips to the humeral crest, from which indeed they might be said to arise, receiving then the main muscular belly. The connection of the marginal tendon with the humerus is always provided with a small tract of strong elastic tissue (*vide* Pl. IV. fig. 7, *t.p.l'.*), and another such tract of longer extent is found on its course opposite the bend of the elbow (Pl. IV. figs. 3 and 7).

In other respects the development and distribution of these tendons differs much in different groups of genera, and their arrangement will therefore be here considered *seriatim.*

It is in the Oceanitidæ that the disposition of the tendon of the *tensor patagii brevis* (*t.p.b.*) is simplest, it here, in all the four genera, passing straight downwards as a thin band, parallel to the humerus, to be lost on the fascia covering the outer side of the forearm. In *Procellaria*, *Cymochorea*, *Halocyptena* and *Pelecanoïdes* (*vide* Pl. IV. fig. 6) it is nearly equally simple, but as it passes over the superficial belly of the *extensor metacarpi radialis longior* (*e.m.*) it gives off to it a small tendinous slip, which lies on the wristward side of the main tendon.

In the genus *Prion* (Pl. IV. fig. 1) the condition of things is slightly more complicated. The superficial belly of the *extensor m.r.l.*, (*e.m.*) is quite tendinous throughout, with no fleshy fibres at all; where the *tensor patagii brevis* (*t.p.b.*) crosses it the two tendons are firmly fused together, and there is also a well-developed wristward slip sent off from the main tendon of the *tensor patagii* to meet the extensor tendon beyond this junction. The main *tensor* tendon where it crosses the extensor muscle is quite free from it in most cases, though occasionally a few fleshy fibres may arise from its anterior margin to join the deeper belly of the *extcnsor m.r.l.*, (*e.m*). In a specimen of *Prion banksi* the wristward slip goes mainly to the deep belly of the extensor, sending off a thin band to the more superficial one. From the point of junction of the wristward slip with the extensor tendon, a thin fan-shaped tendinous fascia is sometimes sent off to the patagium generally.

In *Œstrelata brevirostris* (Pl. IV. fig. 2) the condition of things is similar, but the patagial fan is more strongly developed, and the tendinous superficial part of the *extensor metacarpi* is split, proximad of the *tensor patagii*, one part arising superficially to, the other (*e.m.**) deep of, the prominent supracondylar humeral process.

In the genus *Œstrelata* proper—as represented by *Œstrelata lessoni* (Pl. IV. fig. 4), *Œstrelata mollis*, and an undetermined species—the arrangement differs considerably from that observed in *Œstrelata brevirostris*.[1] The *tensor patagii brevis* tendon, which is more or less fused above with the marginal *tensor patagii longus* tendon (*t.p.l.*), develops at its junction with the superficial tendon of origin of the *extensor* (*e.m.*)—this being, as in *Œstrelata brevirostris*, double—a small, elongated ossicle (*a*) from which arise not only tendinous fibres—some of which form a patagial fan, whilst others join the marginal tendon directly—but also a number of muscular fibres which form the belly of the superficial part of the *extensor*. The *tensor patagii brevis* continues on in the usual manner to the ulnar fascia. No bony nodule, it is to be observed, is found in the tendon of the superficial part of the *extensor* where it arises from the humerus.

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[1] The condition above described as obtaining in *Œstrelata brevirostris* was exactly the same in all the specimens, eight in number, dissected. Unfortunately all these were young birds, though the largest must nearly have attained its mature plumage, and was probably able to fly. In other young birds in the group that I have examined the disposition of these elbow tendons is always exactly the same as in the adults, and even when these last develop ossicles here, such ossicles can be found, in a cartilaginous condition, in quite young birds. I have no reason therefore to suppose that the differences described here as existing between *Œstrelata brevirostris* and the other species of that genus are due to any difference in age.

[*P.S.*—Since the above was written, Mr. R. Ridgway has been kind enough to examine, at my suggestion, the skins of this species in the Smithsonian Institution, and finds, as he informs me, no difference in the development of the ossicle between this and the other species of the genus. The question, therefore, requires further material to elucidate it.]

In *Majaqueus* (Pl. IV. fig. 7), *Bulweria*, and *Puffinus* the *tensor patagii brevis* (*t.p.b.*) tendon is not fused with the much broader and stronger *tensor patagii longus*, but is a distinct, very slight, slip, lying between this and the humerus.

At the elbow it joins the superficial ossicle (*a*), developed at the junction of the *tensor patagii* with the *extensor* tendons. In *Puffinus* (*brevicauda* and *obscurus*) this thin *tensor patagii brevis* is split below into two slips, one joining the deeper of the twin tendons of origin of the superficial *extensor*, whilst the other is inserted on the supracondylar process. The ossicle is larger than the corresponding one of *Œstrelata*, and of somewhat smaller form; from it spring both tendinous fibres for the patagial tendon, and fleshy fibres for the superficial belly of the *extensor* (*e.m.*); from it also, or from the fibres of the last muscle, passes off a thin tendinous fasciculus (*f.*) to the ulnar fascia. Proximad of this larger ossicle is a smaller, more circular, one (*a′*), which is developed in the more superficial of the twin tendons already described a little beyond its origin, where it plays over the supracondylar process. This second ossicle is very small in *Bulweria*.

In the genera *Pagodroma*, *Daption*, *Fulmarus*, *Thalassœca*, *Aeipetes*, and *Ossifraga*, no bony nodules are developed, but the arrangement of these tendons at the elbow becomes very complicated. Their arrangement in *Ossifraga*, with which the others are almost identical, is represented in Plate IV. fig. 5.

The *tensor patagii longus* (*t.p.l.*) tendon divides near the elbow into two parts, one continuing as the marginal patagial tendon, provided with the usual cushion of elastic tissue opposite the bend of the arm, the other receiving the much thinner *tensor patagii brevis* (*t.p.b.*). The united tendon so formed becomes somewhat diffused distally, and more or less fused with the superficial tendon of origin of the *extensor metacarpi radialis longior* (*e.m.*), from which it is continued onwards to the ulnar fascia by two well-defined bands. Between the most wristward of these and the marginal tendon of the patagium there is developed a narrow vinculum.

In addition to this the main tendon of the *tensor patagii* which has a clear, well-defined edge on its humeral side, where it crosses the *extensor* muscle, sends a small special slip of tendon (*t.p′.*) to the deeper of the two bellies of that muscle.

In the Diomedeinæ the arrangement (Pl. IV. fig. 3) more resembles that of the Puffineæ, as here also two ossicles are developed with nearly the same relationships to their surroundings as in that group. The *tensor patagii brevis* (*t.p.b.*) is separate from the *tensor patagii longus* (*t.p.l.*) till near the elbow, the marginal tendon of the latter muscle having received, a little before, the very long and thin tendinous biceps slip (*b.s.*).

The relations of the ossicles are very nearly as in *Majaqueus* (*vide* the figures), but the tendinous band to the ulnar fascia—which represents the morphological termination of the *tensor patagii brevis*—arises in the Albatrosses nearer the middle of the fibrous tissue lying between the two ossicles. As in the Œstrelateæ and Puffineæ, the tendon of origin of the superficial part of the *extensor metacarpi* (*e.m.*) is double, and in the figure an arrow is introduced between them to show this double nature. The proximal and smaller of these two ossicles is developed, as before, in the more superficial of these twin tendons. The larger of the two ossicles is somewhat different in shape in the Albatrosses and Petrels, being more hammer-shaped in the latter group.[1]

The presence of these peculiar wing-ossicles is thus confined to the Diomedeinæ, and to the genera *Majaqueus*, *Puffinus*, *Bulweria*, and *Œstrelata* (in which last there is only one), and, according to Reinhardt (*s.c.*, p. 133) *Adamastor*, of the Procellariinæ. In the genus *Fregata* there is a similar small bony nodule developed at the point where, as in the Petrels, the inner part of the *tensor patagii longus* tendon meets the tendon of the superficial belly of the *extensor metacarpi*, and from it radiate out tendinous fibres to the patagial margin. I have observed similar ossicles, developed at points of intermittent straining, in several other birds, as *Larus argentatus* and *glaucus*, *Fratercula arctica*, and *Merops*.

These bones must be considered to be of the nature of sesamoids, which, as is well known, are often developed in the tendons of muscles at the points of greatest strain. Their occurrence therefore in different groups of birds is by no means a proof of any genetic connection between such.

Biceps.—This muscle, in all Tubinares, is remarkable for its excessive reduction, the muscular bellies being small and short, and the tendon of insertion excessively narrow and thin (*vide* Pl. IV. figs. 1, 4, and 6, *b*).

It is best developed perhaps in the Diomedeinæ, where as usual it arises by two heads, a coracoid and humeral (*vide* Pl. III. fig. 5, *c.*, *h.*), both, however, being largely tendinous, and soon uniting. From the coracoid head is given off a very narrow slip, chiefly tendinous with a few fleshy fibres only, which runs down in the patagium, and joins the margin of the patagium formed by the *tensor patagii longus* close to the elbow (Pl. III. fig. 5, and Pl. IV. fig. 3, *b.s.*).

In the Oceanitidæ the *biceps* muscle is very slender. It has the two usual heads of origin, the tendons of these being often closely united together by fibrous tissue, and ending in a small short, common belly. This apparently gives off no "biceps-slip" at all.[2]

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[1] *Cf.* also the figures of these ossicles given by Reinhardt (*s.c.*, p. 128).

[2] The dissection of these parts in this group of birds is attended with considerable difficulty, partly owing to the smallness of the various parts involved, partly to the great accumulations of fat round the tissues, making the true nature of these very difficult to determine in spirit specimens. It would be very desirable to dissect out these parts in fresh specimens.

In nearly all the other Procellariidæ, including *Pelecanoïdes*, the *biceps* becomes modified in a peculiarly interesting way. The coracoid head alone forms the muscle proper, whilst the humeral head, becoming detached from the coracoid head, goes *entirely* to the *tensor patagii longus* tendon, which it joins as a short, cylindrical tendon close to the shoulder (Pl. III. fig. 4, *h.*). It is, therefore, functionally a "biceps-slip," though it differs from the ordinary "biceps-slip" found in so many birds,[1] in that it arises independently from the humerus, and is not a part of the true *biceps* muscle, although it is supplied by the same nerve as that which goes to the coracoid head. In *Diomedea*, it is to be observed, the "biceps-slip" is derived from the *coracoid* head alone, whereas in the other Procellariidæ this slip represents the shorter or *humeral* head of the normal muscle.

Only occasionally have I seen (*e.g.*, in specimens of *Procellaria pelagica*, *Cymochorea leucorrhoa*, *Œstrelata lessoni*, and *Prion banksi*) a very small tendinous slip derived from this humeral head, which may be either continued downwards with the nerves and vessels to the elbow, where it is apparently lost in the general fascia, or joins the tendon of the true "biceps" (*Procellaria*, *Cymochorea*).

Supposing this latter to represent a more primitive condition, now nearly or quite lost in most of the species, the biceps muscle must originally have been two-headed, with a patagial slip derived from its humeral head. This slip gradually increased at the expense of the other tendon of the humeral head, till eventually the latter disappeared altogether, the *biceps* proper (*i.e.*, that flexing the forearm) being then reduced to its coracoidal moiety.

Expansor secundariorum.—This peculiar muscle[2] is wanting altogether in the Procellariidæ. It occurs, however, in the Oceanitidæ, though in a form different from any previously observed, being attached to (or derived from) thoracically the surface of the *pectoralis major* muscle (*vide* Pl. III. fig. 3).

Its small belly is attached to the few last secondary remiges (*S.*) at the elbow, and the thin tendon (*e.s.*) runs parallel to, but behind, the humerus, to the axilla, where it is joined by a similar but shorter tendon, which is derived from the most posterior feathers of the humeral tract, the so-called "scapularies" (*Sc.*). The common tendon then runs forwards, being superficial to the extensor and flexor muscles and the nerves and vessels of the forearm (*v.n.*), to be attached to the surface of the first pectoral (*p.* 1) close to its insertion into the humerus. In no other instance, so far as I know, does the *expansor secundariorum* become thoracically attached to the *pectoralis primus*, though it may be so to the *teres*, *coraco-brachialis longus*, or *coraco-brachialis brevis* muscles. Nor have I yet met with any other bird in which the tendon of this muscle is connected to the scapularies, which here it serves to expand as well as the secondaries.

The attachment of this muscle to the *pectoralis* suggests that the *expansor secundariorum* may originally have been formed from a cutaneous branch of the former similar to others of the same function derived from it, which are still broad thin expansions of muscular fibres. In other birds this has either completely disappeared, or has developed thoracically new attachments to other muscles or to bone.

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[1] *Cf.* Garrod, Coll. Papers, p. 324.

[2] *Ibid.*, pp. 323-324.

As regards the other muscles of the anterior extremity, the deltoid is always remarkable for its shortness, extending but a very small distance down the arm (*vide* Pl. IV. fig. 7, *d.*) frequently allowing the anterior belly of the *latissimus dorsi* (*l.d.*) to appear superficially below it. Only in *Phœbetria fuliginosa* (a nestling specimen) have I found the special tendinous slip of origin from the scapula which is found in so many birds.

The *triceps* has a well-marked tendinous attachment to the humerus superficial to the insertion of the *latissimus dorsi.* Its muscular belly arises from the scapula by fleshy fibres, and is comparatively short, its tendon, on the other hand, being long, and not joining the tendon of the *biceps* till over the elbow.

The *latissimus dorsi* is in two bellies, as in birds usually; of these the posterior is much the largest, the anterior being comparatively small and narrow.

Posterior extremity.

The *gluteus primus* is nearly always very small, scarcely or not at all covering the *biceps cruris* (*vide* Pl. V. fig. 1). It is larger in the Oceanitidæ, especially in *Oceanites* (*t.c.*, fig. 3, *gl.* 1) and *Garrodia*, where it does cover the *biceps* to some little extent anteriorly.

The *gluteus quintus* appears to be absent, or not differentiated off from the posterior fibres of the preceding, in all the Tubinares, except the Diomedeinæ, where it can be distinctly defined.

The *ambiens* is present and usually well-developed in all the Tubinares, except the genera *Fregetta* of the Oceanitidæ, and *Pelecanoïdes* amongst the Procellariidæ, in which it is quite absent.

In *Pelagodroma, Oceanites,* and *Garrodia* its fleshy belly is of fair size, but the tendon I have been unable to trace across the knee, it apparently terminating on the cnemial process of the tibia. In the other genera this tendon crosses the knee as usual, passing in front of the patella, when that is ossified, between the great cnemial process of the tibia and the end of the femur, and ends as usual in the leg.

The *femoro-caudal* is always present in the form of an usually not broad ribbon, inserted about half way along the femur (Pl. V. figs. 2–4, *f.c.*). It does not pass through, as it does in some of the Ciconiiform birds, a sort of pulley formed by the posterior angle of the pelvic bones.

The *accessory femoro-caudal* (Pl. V. figs. 2, 3, *a.f.c.*) is always present and well-developed, except in the genera *Bulweria* and *Pelecanoïdes* (*t.c.*, fig. 4), where it is quite absent. It is fairly broad and ribband-shaped, overlapping the *semi-membranosus* in the Oceanitidæ at its origin, and inserted into the femur together with the femoro-caudal. In the genera *Fregetta*, *Puffinus*, and *Majaqueus* it is decidedly small.

The *semi-tendinosus* (*t.c.*, figs. 1–3, *s.t.*) muscle is always present and strong. It arises from the iliac bone round its most posterior angle, and has no connection at all with the caudal vertebræ. Anteriorly it slightly overlaps the *biceps*.

Excepting in the Oceanitidæ, it has no accessory head, so that all its fibres are inserted by a thin, broad tendon, quite distinct from that of the *semi-membranosus*, on to the tibia. In the Oceanitidæ, in all the species and genera, there is a strong and broad accessory head, arising from the femur, as usual, and joining the main belly of the muscle by an oblique tendinous raphè (*vide* Pl. V. fig. 3, *a.s.t.*).

The *semi-membranosus* (*t.c.*, figs. 1–3, *s.m.*) is always very large, of broad, flat, ribband shape, not so parallel with the *semi-tendinosus* nor so covered by it, as usual, its direction being more oblique than is that of the other muscle, and thus more parallel to that of the adductors. It arises from the posterior margin of the ilium, ischium, and pubis, from a little above the ischial prominence to within a small distance of the end of the pubis. Its insertion is by a thin, broad tendon, anterior to, and separate from, that of the *semi-tendinosus*.

Of the other muscles in the hind-limb the *biceps* always passes through a tendinous loop on its way to its insertion, as is nearly always the case with birds.

The *obturator externus* is never large, and is inserted near the femur head. The *obturator internus* is of peculiar shape, nearly oval, but with a slight indication of becoming triangular. The deep flexors of the toes and of the hallux blend, usually about half way down the leg, and their tendons may become ossified. Even when a hallux is present it receives no tendon at all from these muscles.

4. Other Anatomical Features.

There are always two carotid arteries situated in the hypapophysial canal. There are also two jugular veins, the right of which is frequently the largest.

The main artery of the leg is always the sciatic one, accompanying as it does the sciatic nerve.

In the genus *Pelecanoïdes*, as has already been described by Garrod (*cf. antea*, p. 10), the femoral vein, instead of being, as usual in birds, deep of the femoro-caudal muscle,—from the external border of which it then seems, in the ordinary course of dissection for the thigh-muscles, to emerge (Pl. V. fig. 2, *f.v.*),—is superficial to it, appearing at the external edge of the obturator externus, and then crossing the femoro-caudal superficially as represented in Pl. V. fig. 4, *f.v.*

In the Procellariidæ, except *Pelecanoïdes*, the two most anterior air-cells, which lie between the rami of the furcula at the entrance to the thorax, are not, as is usually the case in birds, fused together to form an interclavicular air-cell, but—at least in all the species in which I have examined into this point—remain partially distinct, being separated for the greater part of their length by a median septum formed by the coalescence of their internal walls—and double in consequence—but imperfect behind in the middle line, so that there is here a free communication between the two cells over the trachea. In the Oceanitidæ and *Pelecanoïdes* the ordinary structure prevails.[1]

There are always large supra-orbital glands, which occupy depressions excavated for them in the top of the skull (*vide* Pl. VI. fig. 3), and open by a small duct into the nasal cavities. Similar glands occur in many birds, notably the Penguins, Colymbidæ, Auks, Gulls, and many others.[2]

As in all other Ciconiiform birds, there is no true penis developed.

5. TRACHEA AND VOCAL ORGANS.

The trachea in all Tubinares is a straight, simple tube, never convoluted in any way, and with the normal structure of this organ in birds. In some of the genera—*Fulmarus*, *Thalassæca*, *Aeipetes*, and *Ossifraga*—it is divided, as will be described in detail further on, to a greater or less extent by a median longitudinal septum, as in the Penguins alone of other birds so far as I know. The trachea has the ordinary long lateral muscle on each side, as well as a pair of well-developed sterno-tracheales, these arising from the costal processes of the sternum, as in so very many birds.

The constitution of the syrinx, or lower larynx, differs very considerably in the different genera and groups of the Tubinares as regards the number and modifications of form of the various tracheal or bronchial rings that enter into its composition. When as, *e.g.*, in the Gallinæ, the syrinx has no intrinsic muscles, the only guides for determination of the exact rings forming the syrinx are the variations in form of the rings themselves, according as to whether they are tracheal or bronchial, and the facts elucidated by a comparative study of these parts in a series of genera. Such a study of the syrinx in the Tubinares has made it evident to me that in this group at least the attachment of the intrinsic syringeal muscles (of which of course there are only a pair) to a particular bronchial semi-ring is constant, thereby affording a landmark by which the contiguous rings on both sides can at once be assigned to their proper position. The semi-ring that bears the muscle in the Tubinares is the fifth, the four bronchial rings (or semi-rings) above it, as well as a less or greater number of the last tracheal rings, forming together the framework of the lower larynx. In most cases the last tracheal ring bears a well-marked antero-posterior pessular bar.

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[1] In one of the three specimens of *Oceanites* examined, there appeared to be a division of the interclavicular air-cell into two, as in the Procellariidæ.

[2] *Cf.* Nitzsch's article, "Ueber die Nasendrüse der Vögel," Meckel's Archiv, 1820, pp. 234–269.

It is in the genus *Pelecanoïdes* (figs. 3, 4) that the typical construction of the syrinx of the Tubinares is seen in its simplest form; it will, therefore, be described first on the present occasion.

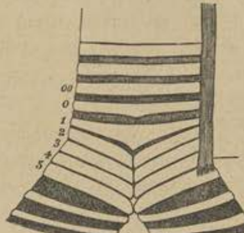

FIG. 3.—Syrinx of *Pelecanoïdes urinatrix*, from before.[1]

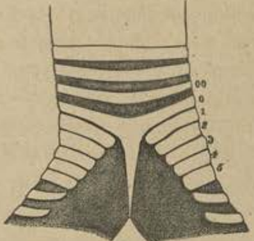

FIG. 4.—The same, from behind.

The last tracheal ring is complete in front, and not modified in shape; posteriorly it is produced downwards into a well-developed pessulus, so forming a complete three-way piece. The first bronchial semi-rings are united in front, where they are produced triangularly downwards; behind, their inturned ends do not unite either with each other or with the pessulus, or with the second semi-rings. These last, as well as the third, fourth, and fifth, on which is inserted the muscle, are all similar in shape, and separate from each other; they are closely approximated in front, gradually getting shorter posteriorly.

Garrodia, which may be considered typical of the Oceanitidæ, is anteriorly (fig. 5) almost the same as *Pelecanoïdes*, but the first, second, and third bronchial rings are complete (fig. 6). The last tracheal ring bears a complete pessulus (5, *a*).

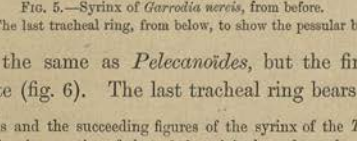

FIG. 5.—Syrinx of *Garrodia nereis*, from before.
a. The last tracheal ring, from below, to show the pessular bar.

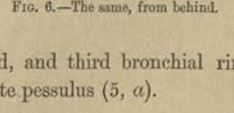

FIG. 6.—The same, from behind.

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[1] This and the succeeding figures of the syrinx of the *Tubinares* have been drawn as nearly as possible of one uniform size, irrespective of that of the originals, and are also slightly diagramatic. The bronchial rings are numbered from 1–5; the tracheal are marked 0, 00, 000, &c., in the reverse direction.

A very similar type of syrinx prevails in the other Oceanitidæ, and is also that found in the genera *Procellaria* (figs. 7, 8), *Cymochorea* (figs. 9, 10), and *Halocyptena*. In all these the first few bronchial rings closely resemble in character tracheal rings, being nearly straight, closely apposed to each other, and more or less ossified. Anteriorly they may be united with one or more of the preceding tracheal rings, and very frequently the first two, or three are quite complete here in the middle line. There is always a well-developed and complete pessular bar, supported behind by the last tracheal ring. With this bar one or more (sometimes three or four) of the bronchial rings may fuse by their coalesced ends posteriorly, forming a broad three-way piece ; or these rings may be complete rings closely apposed, though apparently not anchylosed, to each other in the pessular bar. Different specimens vary slightly in the exact number and disposition of these bronchial rings, and sometimes are not exactly similar on the two sides.

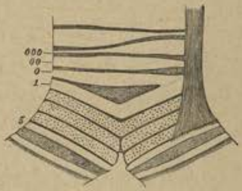

FIG. 7.—Syrinx of *Procellaria pelagica*, from before.

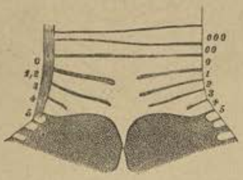

FIG. 8.—The same, from behind.

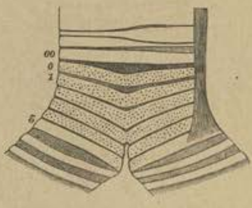

FIG. 9.—Syrinx of *Cymochorea leucorrhoa*, from before.

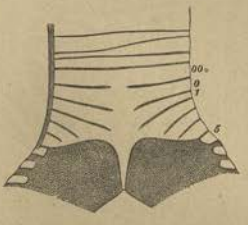

FIG. 10.—The same from behind.

In *Prion vittatus* (figs. 11, 12), the first bronchial ring is either small or fused with the second, which is anteriorly entire: this is not the case with the three succeeding ones. The last three tracheal, and first two—or on one side three—bronchial rings form a pessular box, continuous anteriorly with the inturned anterior ends of the third semi-rings. The fourth pair takes no share in the formation of the box. In *Prion desolatus* there is only one complete bronchial ring, which may be the first, or the first and second united; the others are incomplete, inturned anteriorly, and not co-ossified to form a box. There is a good pessulus borne by the last tracheal.

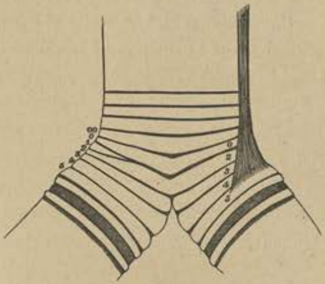

FIG. 11.—Syrinx of *Prion vittatus*, from before.

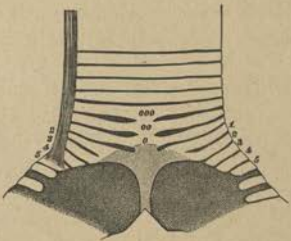

FIG. 12.—The same, from behind.

In *Pagodroma* (figs. 13, 14) the four first bronchial semi-rings are ossified and firmly united into a bony box behind; anteriorly, however, the first and fourth bronchial rings are free, whilst on one side the second and third are quite fused both before and behind. The last tracheal ring is free throughout.

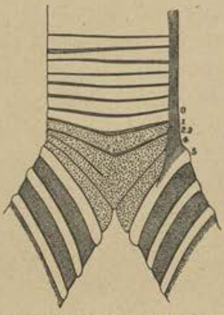

FIG. 13.—Syrinx of *Pagodroma nivea*, from before.

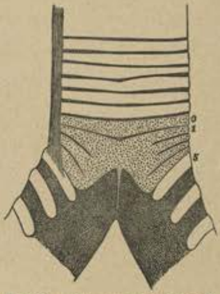

FIG. 14.—The same, from behind.

Daption much resembles *Pagodroma,* there being a bony box, formed however by the fusion of the first three bronchials with the last tracheal ring. In neither of these genera is there any trace of a tracheal septum.

It is by a further development of the syrinx of *Pagodroma* that the peculiar one of the Fulmars is formed.

In *Thalassœca glacialoides* (figs. 15, 16) the last two tracheal rings are ossified and fused together anteriorly, a median descending process being developed which lies between the similarly ossified and fused first three bronchial rings. The fourth pair of rings is also ossified, but free from those that precede it, at least anteriorly. Posteriorly the first four bronchial and last four tracheal rings are firmly co-ossified into a large pessular box, whilst ossification in the median line (both before and behind) of a number of the cartilaginous tracheal rings above this forms the line of attachment for the median septum which divides the tracheal tube for an extent of about 1·25 inch.

In *Fulmarus glacialis* the syrinx is very similar; the four bronchial rings are anteriorly ossified, as are many of the tracheal rings in their median area. The tracheal septum is still more developed than in *Thalassœca*, extending for about the lower two-fifths of the trachea—a distance of nearly 2½ inches.

The extraordinary syrinx of *Ossifraga* is a still further modification of this type (figs. 17, 18, 19). A number of the last tracheal rings (nine on one side, ten on the other, in the specimen—a young one—figured) become completely ossified, as are the first four or five bronchial rings, of which only the first two are complete. The inferior part of the trachea is divided inferiorly for a short way into two quite complete and separate tubes; the posterior ends of the lowest tracheal rings being so much incurved that each actually, inferiorly, forms two complete rings, those of opposite sides being quite separate, whilst above, by the gradual diminution of their opposed interior halves, they become, when viewed from outside, simple rings of the normal tracheal type. On section, however, it is seen that their ends are still incurved to form a tracheal septum like that of *Fulmarus* and *Thalassœca*. This completely divides the trachea into two tubes for a space of about 3½ inches, terminating above by a free semi-lunar border, concave upwards (fig. 19, *c*, *d*). In fig. 19 three sections are given of the inferior portion of the trachea made along the lines *a*, *b*, *c* in fig. 17, to show how the two tracheal tubes, separate below, gradually unite above.

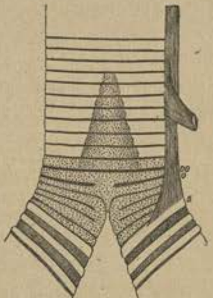

Fig. 15.—Syrinx of *Thalassœca glacialoides*, from before.

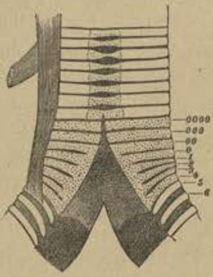

Fig. 16.—The same, from behind.

Aeipetes antarcticus (figs. 20, 21), commonly placed in the genus *Thalassæca* with *Thalassæca glacialoides*, completely differs in the structure of its syrinx from the last three species described, and is more like *Prion*. The two first pairs of bronchial rings are complete anteriorly, the second being ossified, for a small extent only, in the middle

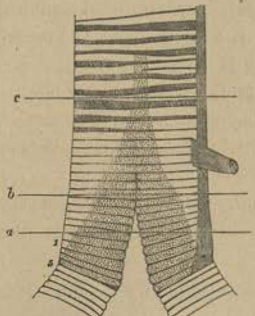

FIG. 17.—Syrinx of *Ossifraga gigantea*, from before.

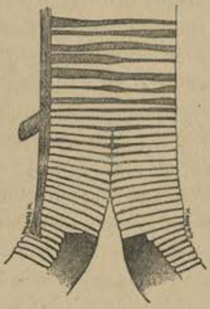

FIG. 18.—The same, from behind.

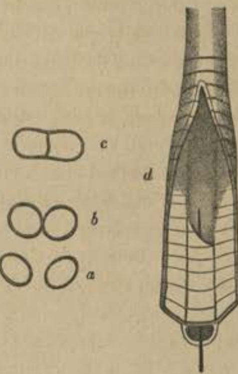

FIG. 19.—*a*, *b*, *c*, sections of syrinx and trachea of *Ossifraga* along the lines *a*, *b*, *c*, of fig. 17, to show the double nature of the tracheal tube below, and its complete division by a median septum above. *d*, trachea opened from the side, to show the median septum, dividing it into two parallel tubes, through the left of which a pointer is passed, below, and terminating above by a free margin.

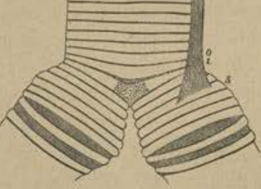

FIG. 20.—Syrinx of *Aeipetes antarcticus*, from before.

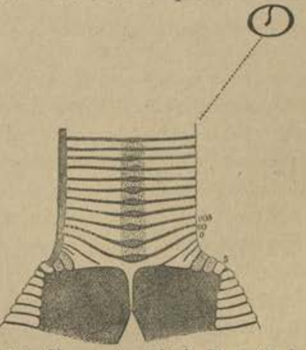

FIG. 21.—The same, from behind. The smaller figure represents a section of the trachea, to show the imperfect septum dividing it.

line. The lowest tracheal ring is quite simple anteriorly, and posteriorly it sends forwards a pessuliform process, anchylosed in front with the second bronchial rings. Two pairs of the bronchial semi-rings (3, 4) are ossified at their posterior extremities, but not fused in any way. The penultimate tracheal and preceding rings are, as in *Fulmarus*, &c., ossified posteriorly in their median (narrowest) portion only to bear the tracheal septum. This, however, is not (*vide* fig. 18, *a*) a complete septum, but is incomplete, the incurved posterior ends of the rings not reaching the anterior wall of the trachea by some little way. Its vertical extent is small, ceasing about ·85 inch above the bronchi.

The peculiar genus *Bulweria* is, perhaps, as far as regards tracheal structure, nearer the small Storm-Petrels (*Procellaria* and *Cymochorea*) than any other group, judging at least from my examination of the syrinx of *Bulweria macgillivrayi*. In this specimen[1] the rings are asymmetrical,—there being only three, instead of four, bronchial rings between the pessular ring and that which bears the muscle on the left side, apparently owing to the suppression of the second bronchial ring, as may be seen in the figures (figs. 22, 23),—and irregularly developed, tending thus to hide the typical form. The last three tracheal rings are, anteriorly, more or less united, there being a pessular bar developed on the inferior margin of the last ring. Posteriorly, the ante-penultimate of these is quite free and complete; the next is incomplete posteriorly, whilst the last is complete on the right side, but anchyloses on the left with the first bronchial laterally. The third bronchial rings on each side are complete, thus encircling the bronchi. The fourth is free and incomplete.

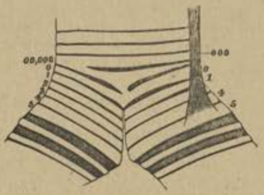

FIG. 22.—Syrinx of *Bulweria macgillivrayi*, from before.

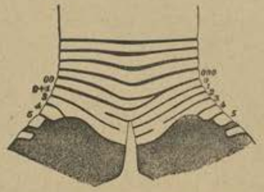

FIG. 23.—The same, from behind.

Puffinus (as represented by *Puffinus brevicauda*) presents a simple form of syrinx (figs. 24, 25), the two first bronchial rings being complete anteriorly, the succeeding two being only semi-rings. The two last tracheal are united with the two first bronchial behind, sending off a pessular process, which anteriorly, as usual, is continuous with the third semi-rings. In younger birds (fig. 26) the various rings concerned remain more distinct, the pessular bar, it is pretty clear, being largely formed by the third semi-rings anteriorly, their backward prolongation fusing behind with cartilaginous elements developed in connection with the posterior ends of the second semi-rings, and all ultimately fusing into the pessular box of the adult. In *Puffinus obscurus* there is a complete pessular bar, formed by the third bronchial rings. There is no pessular box, the bronchial rings being all free from each other.

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[1] Some of the peculiarities here described may be due to its being a youngish bird. I have, unfortunately, as yet been unable to examine the syrinx of *Bulweria columbina*, which might throw some additional light on the subject of the affinities of this genus.

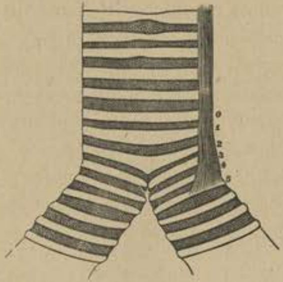

FIG. 24.—Syrinx of *Puffinus brevicauda*, from before.

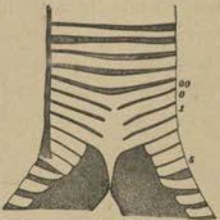

FIG. 25.—The same, from behind.

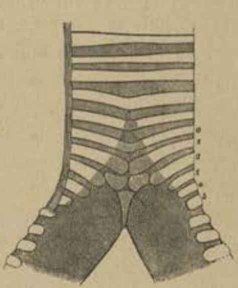

FIG. 26.—The same, from a younger bird, in which the bronchial and tracheal rings have not yet coalesced.

In *Œstrelata lessoni* (figs. 27, 28) the syrinx becomes much more specialised and ossified. The fifth bronchial rings are strong and curved, and to these are attached, by fan-shaped insertions of tendon, the vocal muscles. The five preceding rings (which must therefore be the last tracheal and first four bronchial) are narrow, closely united, and ossified over a rhomboidal space in the middle line anteriorly. Behind there is a pessular box formed by these rings, and the four preceding tracheal ones in addition, the first two of these having a median patch of ossification. There is a well-developed and ossified pessular bar.

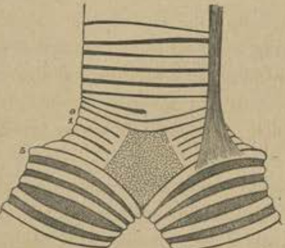

FIG. 27.—Syrinx of *Œstrelata lessoni*, from before.

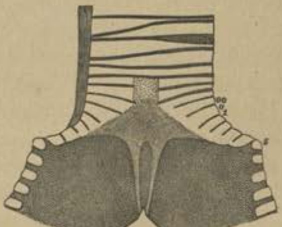

FIG. 28.—The same, from behind.

Œstrelata mollis is quite similar, except that the box is composed of one ring less.[1]

In *Diomedea brachyura* and *exulans* the calibre of the trachea diminishes very considerably below the place of insertion of the *sterno-tracheales.* The syrinx (figs. 29, 30) is strong and well ossified. The fifth bronchial semi-rings on which end the fanned-out tendinous insertions of the intrinsic muscles are strong and much arched. The four preceding bronchial rings, as well as the last tracheal, are ossified anteriorly and posteriorly, and (with the exception in *Diomedea exulans* of the fourth bronchial) co-ossified anteriorly into a strong box, with which the penultimate tracheal ring is also connected in the middle line. Behind, the last two tracheal and first bronchial rings are co-ossified forming a broadly triangular pessular bar or box, whilst one or more (5) of the preceding tracheal rings have patches of ossification mesially.

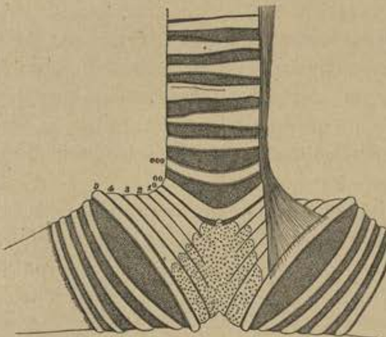

FIG. 29.—Syrinx of *Diomedea exulans*, from before.
About natural size.

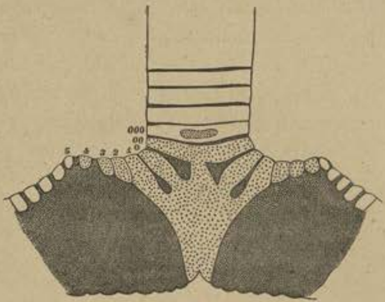

FIG. 30.—The same, from behind.
About natural size.

In *Thalassiarche culminata* (of which I have only examined one) all the five bronchial rings, including the muscular one, are firmly co-ossified together, and free from the rest. There is no complete pessulus, the bony box formed by the rings terminating posteriorly in a straight and free margin, which a cuneate bar, formed by the inturned anterior ends of the fourth bronchial rings, does not reach. The syrinx of *Phœbetria* as yet I only know from a young specimen, in which the bronchial rings below the first are incomplete anteriorly, whilst behind there is a box formed by the last two tracheal and first four bronchial rings.

Majaqueus is very like *Diomedea* in its syrinx, the penultimate tracheal ring, however, being ossified anteriorly, as well as its five successors, which remain free in front. The second bronchial ring is the last entering into the composition of the triangular pessular box behind, the third and fourth rings remaining free.

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[1] I regret not having as yet been able to examine any adult bird of *Œstrelata brevirostris*, all my specimens being young and consequently with the tracheal rings unossified and generally distinct. There is a box formed by the fusion behind of at least three of the bronchial rings with the last, or two last tracheal ones. The second, third, and fourth bronchial rings are united together anteriorly, the third rings joining the pessular bar.

In *Diomedea brachyura* and some of the allied species, the bronchi seem to be, according to the late Mr. Swinhoe's notes, long and convoluted, in a way reminding one of that which occurs in *Ciconia nigra*. I have not observed such convolutions in any Albatross or other Petrel dissected by myself. I herewith append the descriptions given by Swinhoe of this peculiarity.

Diomedea brachyura.—" In the male of this Albatross the bronchi on leaving the trachea bulge considerably as they run horizontally, then contract, and bend forwards and downwards, and lastly, turning sharp round, rise upwards and bulge again before entering the lungs" (Swinhoe, Ibis, 1863, p. 431).

" A female *Diomedea brachyura* had the swollen and convoluted trachea which I thought before was peculiar to the male" (*t.c.*, 1867, p. 227).

Diomedea nigripes.—" In this species the trachea of the female is simple, but that of the male is terminated by large, swollen, convoluted bronchi. In a male specimen, procured in May, the bronchi ran down right and left, almost straight for about $1\frac{7}{10}$ inches, then took a bend forward for a short space, and narrowed, and lastly bending inwards and upwards, bulged largely and entered the lungs" (*l.c.*, 1863, p. 432).

In five adult males of *Diomedea derogata* examined, all had contorted bronchi. These " bulge and go downwards and sidewards, then bend under the ribs on each side into a large globe, pressing between itself and the ribs as each enters the lung at the back" (Proc. Zool. Soc., 1873, p. 785).

6. OSTEOLOGY.

M. Alphonse Milne-Edwards having described at length, with figures, the osteology of the Tubinares in his classical work on fossil birds (*vide supra*, p. 7), whilst other points of their osseous structure have been elucidated by Brandt, Huxley, Reinhardt, and others, as already mentioned in the introductory part, there is not the same necessity for dwelling here on this part of the organisation of the Petrels as was the case when describing the softer and more perishable parts. Moreover, no amount of detailed description of bones, however elaborate or well illustrated, can serve the purpose of scientific research so well as actual specimens, which can in most cases be comparatively easily obtained for, and permanently preserved in, museums.

My study of the osteology of the Tubinares has been chiefly based on the material enumerated in the subjoined list.

List of Osteological Material examined.

OCEANITIDÆ.	
Oceanites oceanicus,	Skeleton.
Fregetta melanogastra,	Do.
Garrodia nereis,	Bones of trunk, and of limbs.
Pelagodroma marina,	Limb-bones.
PROCELLARIIDÆ.	
Cymochorea leucorrhoa,	Skeleton.
Procellaria pelagica,	Do.
Bulweria columbina,	Limb-bones.
Œstrelata "*grisea,*"	Skeleton. (Eyton Coll.).
„ sp. inc. (also named *griseus*)	Do.
„ *lessoni*	Two skulls.
Majaqueus æquinoctialis,	Skeleton.
Puffinus anglorum,	Do.
„ *obscurus,*	Do.
„ *brevicauda,*	Do. (incomplete).
Adamastor cinereus,	Skeleton.
Daption capensis,	Skeleton (Eyton Coll.) and skull
Aeipetes antarcticus,	Do. and two skulls.
Thalasscœa glacialoides,	Do.
Fulmarus glacialis,	Do.
Ossifraga gigantea,	Do. and skull.
Prion desolatus,	Do. and three skulls.
„ *vittatus,*	Skull.
Pelecanoïdes urinatrix,	Skeleton, and sternum.
Diomedea exulans,	Skeleton and skull.
„ *brachyura,*	Do.
Thalassiarche melanophrys,	Do. (Eyton Coll.).
„ *culminata,*	Skull.
Phœbetria fuliginosa,	Two skulls.

The skull (*vide* Pl. VI. figs. 1–6).—The rostrum is long, and strongly-hooked apically. It has no distinct hinge with the cranium proper, but the cranio-facial notch is large, and the nasal and premaxillary bones at their junction with the frontals so thin as to permit of a considerable amount of vertical movement of the beak.

The nares are large and "holorhinal," their posterior boundaries being concave, and not extending, by some way, as far back as the posterior ends of the nasal processes of the premaxillæ. In the Diomedeinæ the nostrils are widely separated, and distinctly lateral in position; in the other forms they are closely approximated, and near the culmen. The nasal septum is but little ossified, most so in the Diomedeinæ. There may be a couple of small ossifications in the floor of the nasal capsules near their anterior extremity, continuous anteriorly with the premaxillæ, united together in the median line, and externally abutting on the outer and lower wall of the nostril.

The skull above the orbits is always deeply excavated for the fossæ in which lie the nasal ("supra-orbital") glands. In the Albatrosses there is a strong raised external border to the fossa posteriorly, prolonged from the post-orbital processes, whilst externally this floor, here perforated by numerous apertures, is deeply excavated.

The post-orbital processes are large and strong. The temporal fossæ are well-developed, nearly meeting across the middle line in most, though in the Albatrosses separated by a considerable interval. The occipital plane is inclined downwards and forwards, but in the Albatrosses is nearly vertical. In these birds the digastric fossæ are continuous, meeting each other in the middle line, whilst in the other Tubinares they are separated to a greater or less extent by the wide, smooth, convex cerebellar eminence.

As might be expected, all these fossæ and their bounding ridges are much better developed in the large Albatrosses and Petrels (*Ossifraga*, *Majaqueus*, &c.) than in the small Procellarieæ and Oceanitidæ, in which the skull is comparatively smooth, of much thinner texture, and with the cerebellar eminence occupying a much greater extent comparatively. The interorbital septum is well ossified in the larger species, most so in *Diomedea exulans*, whilst in the smaller ones it is very extensively fenestrated.

The lachrymal bone is always well developed, but varies in form in the different groups. In the Oceanitidæ and the small Petrels of the *Procellaria*-group it is T-shaped in form, the long arm of the T being horizontal, extending forwards from the body of the bone (which is nearly vertical) to articulate with the external descending process of the nasal bone, just behind the level of the end of the nostril. Between it and the rest of the skull lies a considerable oval fenestra, occupied by membrane in the recent state. The ascending process articulates with the frontal, forming a well-marked, backwardly-directed, antorbital process, whilst the descending process descends downwards towards the jugal arch, to which it may be united by ligament articulating internally with the considerable antorbital plate of the ethmoid ("ectethmoid," Parker).

In *Pelecanoïdes, Puffinus, Adamastor*, and *Majaqueus* it has the same relations, but is more triangular in form, and closely abuts on the cranium superiorly, the fenestra being reduced thus to a chink. In the Albatrosses it also remains separate from the skull, and the anterior limb is but little developed as compared with the vertical part, which is swollen, excavated by air-cells, and forms above a strong antorbital process. It loses its connection with the ethmoid. In the remaining genera the lachrymal does not exist as a free bone, being firmly anchylosed to the frontal above and the ethmoid anteriorly (Pl. VI. figs. 1, 3). It is hollow, with one large, and several small, external apertures.

In connection with the descending limb of the lachrymal bone there is often developed a peculiar ossicle, named by Brandt (*cf. supra*, p. 5), who was the first to describe its existence in *Diomedea brachyura* and *Puffinus major*, the "ossiculum lacrymo-palatinum," from its connection with those two bones.

Its nature and relations in the group have subsequently been more extensively investigated by Reinhardt (*vide supra*, p. 8), who calls it the "os crochu."

When best developed, as in the Albatrosses, the "ossiculum lacrymo-palatinum" is a small styliform ossicle of nearly cylindrical (as in *Thalassiarche culminata*, Pl. VI. fig. 7) or somewhat lamellar (*Phœbetria fuliginosa*, Pl. VI. fig. 8) shape, attached above by an articulation to the inner face of the descending limb of the lachrymal bone, and below connected by a ligament to the upper surface of the palatine bone. Seen from the side, in the dried skull (*vide* Pl. VI. fig. 1) the bone is visible below the malar arch. It lies, in the recent state, in a cavity between the nose and the roof of the mouth, in an oblique position, pointing downwards and inward. This bone is present in all the genera and species of Albatrosses examined by me, as well as in *Thalassiarche chlororhyncha*, as mentioned by Reinhardt. In the Oceanitidæ, in *Procellaria* and *Cymochorea*, as well as in *Daption* and *Pagodroma*, its place is taken by a narrow ligament in which there is no ossification at all. In *Bulweria*, *Pelecanoïdes*, *Fulmarus*, *Thalassœca*, and *Ossifraga* there is a similar ligament, with a small, more or less ossified nodule of bone lying in it, only connected by connective tissue with the surrounding bones. In *Aeipetes*, *Prion*, *Puffinus*, *Majaqueus*, *Adamastor*, and *Œstrelata* it is small and delicate, articulating with the lachrymal above, and ending freely (in the cleaned skull) below.

It is interesting to observe that a very similar bone, both as regards shape and position, occurs in the genus *Fregata* as already pointed out by Reinhardt, whose observation I have been able to verify. But it also occurs in forms so different from these as the Musophagidæ, many Cuculidæ, *Chunga* and *Cariama*, as well as in some Laridæ and Alcidæ, so that its presence is obviously of no particular taxonomic value. Professor Parker informs me that its precise morphological significance is at present rather uncertain.

The palate (*vide* Pl. VI. figs. 2 and 4) is always more or less incomplete below, the fissure dividing it being, by the less degree of inward development of the maxillary processes of the premaxillæ, and of approximation of the inward edges of the maxillo-palatines and palatine bones, longer and wider in the smaller than in the larger forms.

The maxillo-palatine processes are concavo-convex lamellæ, extensively fenestrated, pointing backwards, and with their inner edges appearing but slightly internal to the palatine bones. They remain free from each other in the middle line, and are also unconnected by ossification with the vomer or nasal septum. Hence the Tubinares are in this point strictly schizognathous birds. But in the Albatrosses, where the maxillo-palatines are very large and nearly vertical in position, the space between their inner edges is very narrow, and just in front of them the decurved end of the vomer fills up the intervening chink, especially in *Phœbetria fuliginosa*, where it is firmly fixed to, though apparently not anchylosed with, the maxillary plates. The transition from this to a desmognathous type would therefore be but very slight.

The palatines in the smaller forms are of generally flat form, with their posterior angles rounded off, closely apposed together for a very short way behind the posterior nares, and with fairly developed descending and ascending plates, the latter being recurved posteriorly and anchylosed to the vomer. This latter bone (Pl. VI. figs. 5 and 6) is always broad behind, of generally depressed form, and strongly bent downwards in front, its pointed extremity appearing between the maxillo-palatine processes at about their anterior edge.

In the larger forms the vomer becomes enormously broad, and keeled both above and below. The palatines meet for a much more considerable distance posteriorly, greatest in *Fulmarus*, and their descending plate becomes more pronounced; at its anterior end the bones of opposite sides nearly meet. The ascending plate, too, becomes very large, more or less embracing the vomer at its base, and being separated, especially in the Albatrosses, only by a narrow chink anteriorly from the posterior end of the equally upturned maxillo-palatine. The posterior margin of the palatines is more or less concave. The pterygoids are nearly straight, slightly compressed, cylindrical bones, which articulate mesially partly with the basisphenoidal rostrum, partly with the truncated posterior ends of the palatines. Well-developed basipterygoid facets are present in all the forms (*vide* Pl. VI. figs. 2 and 4), except the Diomedeinæ, the Oceanitidæ, *Procellaria* and *Cymochorea*.[1] The quadrate, as in most birds, is two-headed. Its distal end has two distinct articular cartilage-coated areas, separated by a depression. The most external of these is oblique from behind outwards, and is somewhat saddle-shaped, being convex from side to side, and concave antero-posteriorly. The inner facet has its axis directed forwards and inwards, nearly parallel to that of the pterygoid bone. It is divided by a prominent oblique trochlea into an inner, nearly flat, surface, of triangular shape, and a more external, deeply grooved one, also of saddle shape. As might be expected, these features are less obvious in the feeble and smaller, than in the stronger and larger, species of the group.

The foramen magnum is more or less reniform, with the major axis transverse, in the small species, whereas in the biggest it is oval, especially in *Ossifraga*, with the long axis vertical. The moderately sized species are here again intermediate in structure.

The mandible has no recurved angular process: its posterior end is more or less inturned and truncated behind, the truncated surface being of triangular shape. The articular surfaces are two in number, and, of course, of inverse shape to the corresponding facets on the quadrate bone. One or more pneumatic foramina enter the bone at this point.

Axial skeleton.—The number of vertebræ varies from thirty-eight to forty-two, but that of the cervical ones is always fifteen, as may be seen from the table appended (p. 47). In the Oceanitidæ, it will be observed, the number of cervico-dorsal vertebræ is twenty-one, in the Procellariidæ, it is twenty-two, with two exceptions, where there are as many as twenty-three.

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[1] *Halocyptena* has not yet been examined in this respect: it probably resembles the last two genera named.

The articular cup of the atlas is always incomplete superiorly, the odontoid process of the axis filling up the gap, and so completing the joint. The fifteenth cervical vertebræ has a well developed free rib, which may have an uncinate process, and one or more of the preceding vertebræ—usually two, but sometimes as many as four (*Oceanites*)—have short V-shaped ribs, which do not anchylose with the vertebræ. Sometimes (*Oceanites*, *Prion*) the fourteenth cervical rib is longer, resembling in shape that of the fifteenth, but with no uncinate process.

The dorsal vertebræ[1] are all free, except the last, or occasionally two last, which are anchylosed to those forming the sacrum. They usually have well-developed hypapophyses, especially anteriorly. These are particularly strong and well-developed in *Pelecanoïdes* as in other diving birds (*e.g.*, *Uria*, *Alca*, *Podiceps*), extending there to quite the last dorsal vertebra. In the Diomedeinæ, on the other hand, they are quite absent, or merely represented, on the most anterior ones, by short expanded processes like those of the few last cervical vertebræ.

In nearly all the Tubinares, each of the dorsal vertebral centra has on its sides a distinct oval expression, of varying depth, at the bottom of which, in the largest species, open one or more small pneumatic foramina, to admit air to the interior of the bones. In the Albatrosses, however, these pneumatic depressions are absent, though air is admitted to the bones—which are highly pneumatic here—by a distinct, but small, aperture in each centrum. The transverse processes, too, are in these latter birds very much hollowed out for air cavities.

The ribs in the Oceanitidæ are peculiarly broad, and flattened out dorsally, to an extent not seen in any Procellarian.

In *Pelecanoïdes* the ribs are very long, and oblique in position, the more posterior ones most so, with the angles formed by their vertebral and sternal moities very acute. Thus the whole trunk almost becomes completely surrounded by a bony box, in a way well calculated to resist the pressure of the water when these birds dive. The same modification may be seen well-developed in the diving Alcidæ (*Uria*, *Alca*, &c.).

The uncinate processes are well-developed and nearly straight. They are firmly anchylosed to the ribs.

As may be seen from the table, the number of ribs and uncinate processes varies slightly, and the same is true for the sacral and caudal vertebræ. The latter have well-developed transverse processes, and between their centres inferiorly small chevron bones, smallest anteriorly, larger and double posteriorly, are developed. The last of these may, apparently, anchylose with the body of the corresponding vertebra. The pygostyle is long and compressed. The diving *Pelecanoïdes* has, it will be noticed, a greater number of vertebræ (9) in its tail than the other forms.

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[1] I count all those vertebræ which bear ribs, whether true or false, behind the first dorsal—defined as such by its rib being the first to articulate with the sternum—as "dorsal." The succeeding rib-less vertebræ which are anchylosed together are "sacral," the remaining free ones "caudal."

TABLE SHOWING THE NUMBERS OF THE VERTEBRÆ, RIBS, AND UNCINATE PROCESSES.

Name.	Cervical.	Dorsal.	Sacral.	Caudal.	Total No. of Vertebræ.	Ribs.	Uncinate Processes.
Oceanites oceanicus, . . .	15	6	9	8	38	8 (2 + 6)	5 (15C. 1 – 4D.)
Garrodia nereis, ...	15	6	9	(?)	(?)	7 (1 + 6)	6 (15C. 1 – 5D.)
Fregetta melanogastra, . . .	15	6	9	8	38	7 (1 + 6)	5 (1 – 5D.)
Cymochorea leucorrhoa, . .	15	7	10	7	39	8 (1 + 7)	6 (1 – 6D.)
Procellaria pelagica, . . .	15	7	9	7	38	8 (1 + 7)	6 (1 – 6D.)
"*Œstrelata grisea*" (a), . .	15	7	11	7	40	8 (1 + 7)	5 (1 – 5D.)
" " (b), . .	15	8	10	8	41	9 (1 + 8)	6 (1 – 6D.)
Majaqueus æquinoctialis, . .	15	8	11	7	41	9 (1 + 8)	6 (1 – 6D.)
Adamastor cinereus, . . .	15	7	12	7	41	8 (1 + 7)	5 (1 – 5D.)
Puffinus anglorum, . . .	15	7	12	8	42	8 (1 + 7)	5 (1 – 5D.)
" *obscurus*, . . .	15	7	11	8	41	8 (1 + 7)	5 (1 – 5D.)
Daption capensis, . . .	15	7	11	7	40	8 (1 + 7)	6 (1 – 6D.)
Acipetes antarcticus, . . .	15	7	11	7	40	8 (1 + 7)	6 (1 – 6D.)
Thalassœca glacialoides, . .	15	7	11	8	41	8 (1 + 7)	5 (1 – 5D.)
Fulmarus glacialis, . . .	15	7	11	8	41	8 (1 + 7)	5 (1 – 5D.)
Ossifraga gigantea, . . .	15	7	11	7	40	8 (1 + 7)	5 (1 – 5D.)
Prion desolatus, ...	15	7	10	7	39	9 (2 + 7)	6 (15C. 1 – 5D.)
Pelecanoïdes urinatrix, . . .	15	7	10	9	41	8 (1 + 7)	6 (1 – 6D.)
Diomedea exulans, . . .	15	7	12	6	40	8 (1 + 7)	5 (1 – 5D.)
" *brachyura*, . . .	15	7	12	7	41	8 (1 + 7)	5 (1 – 5D.)
Thalassiarche melanophrys, . .	15	7	12	7	41	8 (1 + 7)	5 (1 – 5D.)

Pectoral arch.—The sternum (Pl. VII.) is usually rather broad and short, much longer in *Pelecanoïdes* than in any other genus, with a well-developed keel, and a short, but distinct manubrium—obsolete in *Pelecanoïdes.* The costal processes are triangular in shape, directed outwards, or in the Oceanitidæ and *Pelecanoïdes*, forwards and outwards. The anterior margin of the keel is more or less excavated, with its lower angle produced forwards, most so in *Puffinus anglorum.* In *Pelecanoïdes* (Pl. VII. figs. 3, 4) this part articulates with the clavicular symphysis, instead of being merely connected to it by ligament, as in the other forms. The coracoidal grooves are oblique backwards, and present two distinct articular areas for the articulation of the coracoid bone. The sides of the sternum usually converge towards the lower end of the costal process, and then diverge again to their posterior extremities. As may be seen from the figures of Plate VII.

the posterior end of the sternum varies a great deal in its outline in different members of the group.

In most of the larger forms of Procellariidæ, the visceral aspect of the sternum presents, towards its anterior extremity, more or fewer pneumatic apertures, which are best developed in the Albatrosses, where the whole bone is much permeated with air. In *Fulmarus*, and all the smaller forms of Procellariidæ, as well as in the Oceanitidæ, the sternum has no pneumatic apertures at all, and does not contain air.

In the genera *Cymochorea* (fig. 5), *Procellaria*, and *Halocyptena*, as also in *Fregetta* (fig. 7) and *Garrodia*, the posterior margin of the sternum is entire, with only a very slight concavity in the outline of each side. In the Oceanitine genera *Oceanites* and *Pelagodroma* it is very nearly the same in shape, though each side has a small excavation, the margin between the excavations being convex. In *Pelecanoïdes* (fig. 3) also the sternum is nearly straight posteriorly. In the Diomedeinæ (*e.g.*, *Thalassiarche melanophrys*, fig. 1) the posterior angles of the sternum are produced backwards and outwards considerably, and its posterior border is broadly excavated by a sinuous curve, convex externally, concave mesially. In *Diomedea exulans* the inner concave part is divided into two smaller concavities on each side by a process of bone, so that the posterior margin presents four slight notches, the inner pair being the bigger.

In the remaining genera of the group, the posterior border of the sternum is always more or less four-notched posteriorly, the notches being generally best developed and deepest in the genera allied to *Puffinus* and *Majaqueus* (figs. 9–13), whilst in the Fulmarine forms the notches are smaller and tend to be irregular. *Bulweria* (fig. 16) departs widely from any of the so-called Storm-Petrels in the form of its sternum, and approaches closely *Œstrelata*, &c. The exact forms of this notching, which is inclined to vary in different specimens, may be best understood from an inspection of the figures. The outer notch may, as in the specimen of *Adamastor* figured (fig. 18), be converted into a foramen by the partial ossification of the membrane filling it.

The coracoid bones in the smaller genera (*vide* Pl. VII. figs. 5–8) are well-developed, with nearly cylindrical shafts, dilated internally at their distal ends to meet the acromial process of the scapula, whilst proximally they are broad and expanded, and produced externally into a pointed, or slightly hooked process. In *Pelecanoïdes* (figs. 3, 4) these bones diverge at a smaller angle from each other than in the other forms; their shafts are less cylindrical, and the proximal ends comparatively little dilated. In the larger forms, on the other hand, the coracoids become very divergent, and the shaft and both extremities, but particularly the proximal one, are much dilated, so as to assume the extraordinary form seen in *Diomedea* (figs. 1 and 2) and its allies, where the greatest transverse diameter of the bone at its base is nearly as great as its entire length. The external outline of the bone is deeply concave, owing to the great development of its external costal process.

The scapula is a slender, slightly curved bone, presenting no special peculiarities. Its acromial process is prolonged inwards and forwards to nearly, or quite, meet the posterior end of the clavicle. The angle it forms with the coracoid varies very much in different genera, being most acute in *Pelecanoïdes*, whilst in the Oceanitidæ it is hardly, if at all, less than a right angle (*vide* Pl. VII. fig. 8, *Fregetta*). *Procellaria* and *Cymochorea* resemble the other Procellariidæ, the coraco-scapular angle being in them obviously (*t.c.*, fig. 6) acute.

The clavicles are always well-developed, strongly convex forwards as seen from the side, and forming a more or less widely-open U when seen from in front. Their posterior ends are produced backwards to unite, by ligament, with the acromial process of the scapula. The symphysis is usually somewhat dilated and thickened and closely apposed to the antero-inferior angle of the sternum, to which it is connected by ligament. In *Pelecanoïdes* the clavicular arch is more V-shaped, its limbs diverging but little, and the symphysis develops a firm articulation with the *carina sterni* (*vide* Pl. VII. figs. 3, 4) as in *Phalacrocorax*, *Sula*, *Plotus*, and *Phaëthon* of the Steganopodes. In the Oceanitidæ (*vide* Pl. VII. fig. 8) the *symphysis furculæ* has a strong, curved hypocleidial process, directed downwards and backwards, very much more developed than the corresponding part in any Procellarian genus, even *Cymochorea* or *Procellaria* (*t.c.*, fig. 6).

Anterior Extremity.—The *humerus* (Pl. VI. figs. 9–11, where that of *Majaqueus æquinoctialis* is figured) is long, with a cylindrical shaft, often much compressed distally in such a way that the outer margin of the bone with its condyle is anterior and the inner one with its condyle posterior. The head is but little elevated above the general level of the proximal end of the bone. The pectoral ridge is prominent and triangular, but short, and the deltoid impression extends only as low as its distal termination. Behind the deltoid impression is a linear one for the *latissimus dorsi*. The bicipital surface is well developed, the lesser trochanter strong and recurved; it is excavated behind and below by a deep infra-capitular fossa, bounded above by the strong interfossal ridge, the supra-capitular fossa being a more shallow concavity. The tubercle for the insertion of the *pectoralis secundus* is strong, and is situated at the commencement of the pectoral crest, just anterior to the articular head. Below and anterior to it is an oval depression, often large, for the *pectoralis tertius*. The external condyle is prolonged obliquely upwards and inwards on the anterior surface of the bone; the capitellum is distinct, and separated by a slight notch from the internal condyle. The olecranar fossa is shallow and prolonged upwards into a smooth, slightly excavated triangular area. The impression for the *brachialis anticus* is deep and oval.

Above the external condyle there is a very strong, forwardly-directed epicondylar process, from which arises the more superficial of the bellies of the *extensor* *metacarpi radialis longior* muscle. This is least developed in *Pelecanoïdes* and *Thalassæca.*

The pectoral crest, on its inferior aspect, presents an elongated surface for the attachment of the great pectoral, coextensive with the lower moiety of its border. This surface develops a roughness at each extremity, particularly below, where the main part of the more superficial layer of the muscle is attached by its strong tendon. The double nature of the pectoral muscle is indicated by a distinct muscular ridge dividing the general area of insertion into two.

In the Oceanitidæ the humerus is conspicuously a stouter and shorter bone, with its shaft evidently curved, instead of being almost straight. The epicondylar process projects much less forwards, and is continued down by an elevated ridge to the surface of the condyle itself.

In the Albatrosses the humerus is distinctly concave forwards, with its shaft considerably compressed throughout. The pectoral crest is sharply pointed, the bicipital surface very prominent and convex, the internal trochanter less developed, and the infra-capitular fossa very shallow, with its apex occupied by a large pneumatic foramen, and the *brachialis* impression long and very shallow.

In *Pelecanoïdes,* as might have been expected from its diving habits, the humerus is somewhat modified from the ordinary Procellarian type. The shaft of the bone is comparatively short and much compressed, especially below, where it has sharp anterior (external) and posterior (internal) margins. The pectoral crest is little developed. The internal condyle descends considerably lower than the external one, and the capitellar surface is well-developed and compressed. Behind it and the external condylar trochlea is a strongly-marked deep pit, into which fits, like a peg, a sharp conical process developed at the proximal end of the ulna. The epicondylar process is very short, and the depression for the *brachialis anticus* very shallow.

The *radius* is a slender, straight and cylindrical bone, with its distal end depressed and grooved superiorly.

The *ulna* is much stouter, with its posterior edge sharply keeled, with only slight impressions for the secondary remiges. The olecranon process is short and bluntly triangular. In *Pelecanoïdes* the radius and ulna are considerably compressed from before backwards. The ulna is stout, and develops at its proximal end a slightly curved triangular process, directed upwards, which, as already described, fits into a corresponding socket on the humerus, and so firmly unites the bones together.

The *manus* is very long. The second and third metacarpals are nearly parallel and straight, the third metacarpal being much more slender than its fellows. The pollex has but one phalanx, which is strong and long, about equalling one-half of the second metacarpal. The two phalanges of the index are well-developed, the basal one, which does not articulate with the third digit, being much dilated posteriorly.

In the Oceanitidæ the radius and ulna are generally stouter and stronger bones they are in the Procellariidæ; the former is considerably expanded at its distal extremity.

As may be seen by the table at the end of this section (p. 54) the three chief segments of the fore-limb are, as a rule, nearly equal in length, this being especially true as regards the arm and forearm.

Pelecanoïdes alone has the latter much shorter than the arm, the proportions here being three to four. In all the others the humerus and ulna are nearly equal in length.

In most of the genera the manus (excluding the carpus) is the longest of the three segments, but this is not the case in the larger forms (*Adamastor*, *Majaqueus*, and *Ossifraga*) of the Procellariinæ, whilst in the Diomedeinæ the manus is very much shorter, as may be seen by the measurements, than either the humerus or ulna.

Pelvic arch.—The pelvis (*cf.* Pl. VI. fig. 12, pelvis, &c., of *Majaqueus æquinoctialis*) may be described as generally elongated and narrow. The prœ-acetabular is about equal to the post-acetabular axis, though in *Cymochorea*, *Procellaria*, *Pelecanoïdes* and the Oceanitidæ it is considerably longer. In *Puffinus*, on the other hand, the reverse is the case.

The ilia are long and narrow; anterior to the acetabula they are slightly concave plates, with their anterior extremities somewhat rounded off, separated mesially by the sacral vertebræ, the neural spines of which coalesce into a strong median ridge The antitrochanteric eminences are strong, and stand out conspicuously, the iliac bones attaining here their greatest transverse extent, though each bone is narrow and separated by a wide space, occupied by the bodies and transverse processes of the more posterior sacral vertebræ, from its fellow of the other side. A strongly marked post-acetabular ridge runs from here inwards and backwards to the prominent posterior iliac angle, which lies between the transverse processes of the second and third caudal vertebræ. External to the ridge, the iliac surface is nearly vertical.

The ischia are narrow and compressed plates of bone, usually strongly curved downwards posteriorly to articulate with the dilated posterior ends of the nearly straight, slender, pubic bones, each of which has at the level of the anterior angle of the acetabulum, a slight prepubic spine. The posterior ilio-sciatic margin is first strongly concave backwards, and then convex.

Seen from below, the pelvis preserves its generally narrow shape, the pubes being only slightly inturned at their posterior, cartilaginous extremities. The renal fossæ are narrow, fairly deep and confluent. In front they are limited by the transverse processes of the 3rd or 4th sacral vertebræ, which, like those of their predecessors, are short and slender, the 7th, 8th, 9th and 10th of those bones developing transverse processes, which abut against the ilia, and in the larger forms become strong and more or less double.

There is not very much divergence from the general form of pelvis described here amongst the various forms of Petrels. In the Albatrosses it becomes very narrow, especially anteriorly, the renal fossæ being correspondingly narrow and deep. The bones entering into its composition, and supporting it become extensively pneumatic. Anteriorly the ilia unite, or nearly so, over the neural crest, whilst posteriorly the foramina between the transverse processes of the sacral vertebræ become reduced to small holes, owing to the increased amount of ossification. A tendency to similar increased ossification in these parts is discernible in the larger forms of Petrels.

In *Pelecanoïdes* the ischia are nearly straight along their posterior margin.

In *Cymochorea* and *Procellaria*, as well as in the Oceanitidæ, the pelvis generally is weaker, with its posterior region more deflexed. But that of the two former genera may be distinguished from that of the Oceanitidæ by the obsolete condition of the posterior iliac spine, the weakness of the post-acetabular ridge, and the smaller size of the ilio-sciatic and obturator foramina.

Posterior Extremity.—The *femur* is short, and more or less curved, most so in *Puffinus*. The head is a little elevated, and set on nearly at right angles to the long axis of the bone. The external condyle descends lower than the internal, and has a well-marked posterior trochlear surface. The femur of the Oceanitidæ is a stronger and better developed bone, particularly at the two extremities, than it is in the Procellariidæ of corresponding size. The *tibia* is long, especially in the Oceanitidæ, where it is at least twice as long as the humerus. It has a very large and strong cnemial process, best developed in the genus *Puffinus*, for the attachment of muscles, rising high above the articular faces of the femur (*vide* Pl. VI. fig. 13). Its distal end is more or less antero-posteriorly compressed, and has an osseous bridge for the *extensor communis digitorum*. The ridge for the fibula extends for about one-quarter the total length of the shaft of the bone, beginning a little below the external condylar facet.

The *fibula* is a delicate, styliform bone, which may be two-thirds as long as the shaft of the tibia.

The *tarso-metatarsus* has a smooth, rounded, interarticular prominence proximally, and a calcaneal eminence, with two deep grooves, which may become converted into canals, for the passage of the flexor tendons. In the Diomedeinæ this calcaneal process is feebly developed, with but a single groove internally, and a broad trochlear surface, with two shallow furrows, externally. The antero-external margin of the bone is sharply keeled. In such forms as *Puffinus* this keel becomes very sharp and prominent, owing to the greatly compressed form of the leg. Internal to it the bone is distinctly grooved.

Of the articular trochleæ at its distal end, the inner is the shortest and most oblique. Those for the third and fourth digits are more nearly equal, that for the third however being slightly the longer. There is a small foramen between it and the fourth.

In *Puffinus* there is a distinct osseous bridge, developed on the anterior and distal surface of this bone, external to the impression for the *tibialis anticus*, which I have also seen present (on one side only) in *Diomedea exulans*. Usually the bridge remains tendinous.

The three anterior digits are strong and well developed, the third and fourth being nearly equal in length. They have the normal number of phalanges, of which the basal one is always much the longest. In the Oceanitidæ the phalanx of the middle digit always exceeds the two succeeding ones, taken together, in length, whereas in the Procellariidæ it is always shorter, considerably, than these two.

The hallux is altogether absent in *Pelecanoïdes*, and is present only in the most rudimentary form, as already described (*supra*, p. 13) in the Diomedeinæ. In the Oceanitidæ and remaining Procellariinæ it is always present, though small, but is peculiar in consisting of only a single phalanx, which bears the claw (*vide* Pl. VI. fig. 14). It articulates, proximally, with a small metatarsal, which lies in its usual relationship to the cannon-bone formed by the conjoined metatarsals.

In the ordinary Petrels the only pneumatic bones of the skeleton are the skull, lower jaw (around its angle), sternum (very slightly), and the cervical, dorsal, and some of the more anterior sacral vertebræ. The limb bones are all filled with marrow. In the smaller forms indeed of both families only the skull, lower jaw, and a few of the most posterior cervical vertebræ seem to be pneumatic. As a rule there seems to be a gradual increase in the amout of pneumaticity of the bones correlated with the increase of size in the bird generally.

In the Albatrosses the whole of the axial skeleton (excepting some of the ribs, the scapula, furcula, caudal vertebræ, and uncinate processes) becomes extensively pneumatic, the sternum being especially so. The humerus, moreover, becomes hollowed and filled by air, which enters through the pneumatic foramina developed at the bottom of the infra-capitular fossa.

The proportion of the hind, as compared with the fore, extremity, as well as those between different segments of those limbs, are very different, as may be seen from the appended table of measurements (in millimetres), in the Oceanitidæ and the Procellariidæ respectively. In the former the leg, as measured by the combined lengths of the femur, tibia, and metatarsus, and therefore excluding the toes, is longer than the wing (humerus + ulna + manus (omitting the carpals). The tarsus is longer than the mid-toe or ulna, and at least twice as long as the femur. The tibia is at least twice as long as the humerus, and much longer than the manus.

In the Procellariidæ (including the Diomedeinæ and *Pelecanoïdes*) the leg, measured in the same way, is shorter than the wing. The tarsus is not longer than the mid-toe (except in *Procellaria* where it is just) but shorter, and the same is always the case when it is compared to the ulna. It is never twice as long as the femur. The tibia is only a little, or not at all, longer than the humerus or manus.

Name.	Humerus.	Ulna.	Manus.	Femur.	Tibia.	Tarso-Metatarsus.	Middle Toe.
Oceanites oceanicus, . . .	23	21	34	15	50	35	28
Garrodia nereis, ...	20	17	26(?)[1]	14	51	34	25
Pelagodroma marina, . . .	27	24	37	18	60	41	35
Fregetta melanogastra, . . .	27	23	36	19	56	38	26
Cymochorea leucorrhoa, . .	35	35	42	16	37	24	26
Procellaria pelagica, . . .	26	24	33	13	33	22	20
Bulweria columbina, . . .	62	62	63	20	42	28	28
"*Œstrelata griséa*," . . .	81	83	84	31	61	36	43
Majaqueus æquinoctialis, . .	151	154	143	51	116	67	81
Adamastor cinereus, . . .	134	132	127	50	108	62	78
Puffinus anglorum, . . .	79	72	86	31	79	46	51
„ *obscurus*, . . .	66	63	71	25	66	40	44
Daption capensis, . . .	86	84	91	38	80	46	56
Aeipetes antarcticus, . . .	98	93	100	44	88	44	56
Thalassœca glacialoides, . .	115	113	118	48	96	57	68
Fulmarus glacialis, . . .	118	116	117	50	113	54	67
Ossifraga gigantea, . . .	243	236	212	88	184	94	130
Prion desolatus, ...	57	56	56	23	53	32	35
Pelecanoïdes urinatrix, . .	43	33	44	23	46	24	27
Diomedea exulans, . . .	428	417	290	110	246	124	168
„ *brachyura*, . . .	281	285	222	76	175	96	122
Thalassiarche melanophrys, . .	259	262	202	80	161	83	118

IV. THE CLASSIFICATION OF THE *TUBINARES*.

The propriety of the division of the entire order Tubinares into two main families, which must be termed the Oceanitidæ and Procellariidæ,[2] first proposed by Professor Garrod in 1873 (*vide supra*, p. 9), has been fully borne out by my further investigations into the structure of these forms. To the differences in their myological formulæ, and in the presence or absence of cæca, may now be added numerous other points, both external and internal.

The Oceanitidæ agree together in having the following peculiarities which are not shared in—with one or two exceptions marked by an*—by any of the Procellariidæ :—

The number of secondary remiges is never more than ten. The tarsi are not uniformly reticulate, but are either ocreate, or covered by large transversely-oblique scutes anteriorly. The claws are very flat, depressed, and lamellar. There are no colic cæca.* (Absent in *Halocyptena* only of the Procellariidæ.) There is a peculiar *expansor secundariorum* muscle. The tendon of the *tensor patagii brevis* is quite simple throughout. The *semi-tendinosus* muscle has a well-developed accessory head. The *ambiens* muscle, when present, does not pass over the knee, but is lost on the cnemial process of the tibia. The number of cervico-dorsal vertebræ is twenty-one. The clavicles have a long, curved, symphysial process. The leg bones are longer than the wing bones. The tarsus is longer than the mid-toe* and ulna, and at least twice as long as the femur. The tibia is at least twice as long as the humerus, and much longer than the manus. The basal phalanx of the middle toe is as long as, or longer than, the next two taken together.

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[1] Imperfect in the specimen measured. This length is estimated.

[2] *Cf.* Proc. Zool. Soc., 1881, p. 737.

The Oceanitidæ also agree together in having no basipterygoid processes, no uncinate bone, a peculiarly short and stout humerus, radius, and ulna, a single circular nasal aperture, a sternum with its posterior margin quite or nearly entire, a larger *gluteus primus*, as well as in numerous other smaller details already noticed. All these characters never coexist together in any Procellarian form, and, if my observations are correct, the Oceanitidæ further differ from the Procellariidæ by having a *biceps brachii* muscle of the normal form, with no patagial slip.

The Procellariidæ on the other hand, have the following characters:—

The number of secondary remiges is never less than thirteen, and is usually much greater. The tarsi are pretty uniformly covered with small hexagonal scutellæ. The claws are sharp, curved, compressed. Short colic cæca are present.[1] There is no *expansor secundariorum* muscle. The termination of the tendon of the *tensor patagii brevis* is never quite simple, and may become very complicated. There is no accessory head to the *semi-tendinosus.* The *ambiens* muscle (only absent in *Pelcanoïdes*) always crosses the knee. The number of cervico-dorsal vertebræ is not less than twenty-two. The clavicles have only a very small symphysial process. The leg is shorter than the wing. The tarsus is not larger than the mid-toe (except in *Procellaria*), and is shorter than the ulna. It is never twice as long as the femur. The tibia is only a little, or not at all, longer than the humerus or manus. The basal phalanx of the middle toe is shorter than the two next joints. Basipterygoid facets may or may not be present, and the same is true of the uncinate bone. The humerus, radius, and ulna have a shape different from that of the Oceanitidæ. The form of the nostrils, and of the posterior margin of the sternum, varies extensively. The *gluteus primus* is always very small, and there is a peculiarly formed patagial slip derived from the *biceps* muscle.

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[1] *Halocyptena* is apparently an exception to this rule, but as *Cymochorea* has only one cæcum, there is nothing surprising in the reduction being carried a step further. As therefore all the congeners of *Halocyptena* have cæca, it may be safely assumed that their disappearance in it has been very recent, and has occurred since it acquired the rest of its Procellarian characters. This loss of cæca therefore by it does not in any way really approximate it to the Oceanitidæ.

Thus in spite of the general superficial resemblance of the Oceanitidæ to the smaller forms of Procellariidæ, with which all ornithologists previous to Garrod had confounded them, the differences between the two families are, it will be seen, numerous and important. The special points of resemblance which the Oceanitidæ have with such Procellarian genera as *Procellaria* and *Cymochorea*—such as the general small size, style of coloration, form of skull, comparative simplicity of the *tensor patagii* arrangement, simple sternum and syrinx (the last three peculiarities being also common to *Pelecanoïdes*)—may best be explained by supposing that these small Procellarian forms are on the whole less specialised than the larger ones (Fulmars, Albatrosses, Shearwaters, &c.), and so retain more of the characters possessed by the primitive and now extinct common form from which both the Procellariidæ and Oceanitidæ must have been derived.

The Oceanitidæ are a small and, on the whole, compact group, with but few differences of importance between the four genera contained in it. Of such differences the most important are the loss of the *ambiens*, and the very flattened nails and feet of *Fregetta*; the lengthening of the foot in *Pelagodroma*; and the acquisition of an ocreate tarsus by *Fregetta* and *Oceanites*. *Garrodia* is, therefore, on the whole, the least modified form of the group. The four genera may be distinguished as follows:—

Garrodia. *Ambiens* present; tarsus scutellated anteriorly; sternum posteriorly entire.

Oceanites. *Ambiens* present; tarsus ocreate; sternum posteriorly slightly excavated; interdigital webs yellow.[1]

Pelagodroma. *Ambiens* present; tarsus scutellated; sternum and webs as in *Oceanites*; feet very long.

Fregetta. *Ambiens* absent; tarsus ocreate; sternum entire; feet very short, and nails peculiarly broad and blunt.[2]

The Procellariidæ, comprising as they do by far the greater number of species and genera of the group, show much more divergence *inter se* than is the case with the Oceanitidæ. The Albatrosses are by far the most aberrant forms of this group, with which, however, they have all the characters above noted in common, though in themselves specialised in several points. The discovery of a rudimentary hallux, and of an aftershaft in these birds, disposes of two of the characters which have hitherto been available for their separation from the other Tubinares, as do the gradations of form that exist in the amount of separation of the two parts of the dorsal tract of another. As peculiarities of the Diomedeinæ may be included:—

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[1] To the genus *Oceanites* belong *Thalassidroma gracilis* (Elliott, Ibis, 1859, p. 391—the type (?) of which, now in the Smithsonian Institution, I have examined) and *Thalassidroma lineata* (Peale, Orn. U.S. Expl. Exped., pl. xxxix. p. 403). *Thalassidroma segethi* (Philippi and Landbeck, Wiegm. Arch., 1860, p. 282) may be the former bird, or, as suggested by Mr. Salvin (Proc. Zool. Soc., 1878, p. 736), *Fregetta grallaria*.

[2] Besides *Fregetta grallaria* and *melanogastra* there seem to be two other species to be referred here, viz., *Procellaria albogularis*, Finsch, (Proc. Zool. Soc., 1877, p. 722), and *Fregetta mœstissima*, Salvin (Proc. Zool. Soc., 1879, p. 130).

The lateral position of the nostrils.[1] The presence of a distinct *gluteus quintus* muscle. The formation of the *biceps humeri* muscle, which gives off a patagial slip from its coracoidal head. The characteristic sternum. The absence of hæmapophyses on the dorsal vertebræ. The pneumatic *os humeri*. The generally pneumatic condition of the skeleton. The proportion of the manus to the humerus and ulna.

The tongue and palate are also more or less peculiar, and in all the genera there are uncinate bones, no basipterygoid facets, and two large distinct accessory wing-ossicles; the right liver-lobe is also distinctly the larger of the two.

There are apparently three good genera of Albatrosses which may be distinguished, independently of external characters, as follows:—

Diomedea. Tongue very short; uncinate bones more or less styliform. (*Diomedea exulans* and *brachyura.*)

Thalassiarche. Tongue intermediate; uncinate bones styliform. (*Thalassiarche culminata.*)

Phœbetria. Tongue much longer; uncinate bones flattened; hallux better developed than in the other genera, and with an external claw. (*Phœbetria fuliginosa.*)

Neglecting for the present the peculiar diving *Pelecanoïdes*, the remainder of the Procellariidæ forms a natural group distinguished by the following characters from the Albatrosses (Diomedeinæ):—

The more or less dorsal position of the nostrils, the form of which however varies, as has already been described, though they are never lateral. The absence of a *gluteus quintus.* The peculiar form of the *biceps brachii* muscle, which is in two separate parts, the humeral head forming a patagial slip. The presence of hæmapophyses on the dorsal vertebræ, the centre of which are marked by more or less developed pneumatic depressions. The non-pneumatic humerus. The different pterylosis, and the nearly equal size of the lobes of the liver. The greater size of the hallux, which always has a distinct nail externally. (Quite absent in *Pelecanoïdes.*)

Pelecanoïdes is, in some respects, as much specialised as the Albatrosses, though many of its modifications are distinctly traceable to its diving habits, as, *e.g.*, the compressed form of the wing bones, the great development of the hypapophyses of the dorsal vertebræ, the elongated sternum and pectoral muscles, the peculiar ribs. But it stands alone (amongst the Procellariidæ) in the absence of the *ambiens* muscle; the peculiar disposition of the femoral vein; the absence of a hallux; and the single interclavicular air-cell. Moreover, as in *Bulweria* only of other Tubinares, its myological formula is A.X., there being no accessory head to the femoro-caudal muscle.

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[1] This feature, in which the Albatrosses are apparently more primitive than are either the Oceanitidæ or the other Procellariidæ, can hardly, if my views about the relationships of these groups to each other be correct, be considered to have been a character of the common Petrel-ancestor. It may be more probably explained as due to arrested development during embryonic life, as a study of the development of the nostrils of other Petrels would probably show that these are actually, at some time, lateral, and subsequently coalesce.

But *Pelecanoïdes* shows marks of being in some respects an early form in the simple condition of the *tensor patagii* muscle, in its very simple syrinx, and in the general shape of its sternum. It has the characteristic form of *biceps* muscle found in all the Procellariidæ, except the Albatrosses, and like all those forms, except the *Procellaria*-group, has basipterygoid facets.

Pelecanoïdes is thus, as will be seen, a very well-marked form, though it is somewhat difficult to decide as to whether its peculiarities are such as to entitle it to form a separate sub-family by itself. The presence of basipterygoid facets would seem to indicate that it probably diverged from the general stock of the Procellariinæ at a point when the latter had already developed that feature, and therefore at a period after the ancestor of the *Procellaria*-group—in many ways the least specialised, and therefore presumably more ancient, of the sub-family, and in which there are no such facets—had already acquired its main characters.

According to modern ideas, the object of a classification is not so much to represent morphological facts as to indicate the phylogenetic relations of the different forms concerned. According to the first view, *Pelecanoïdes* might well be placed, as many authors have done, in a special group of its own; but if we admit, as seems on the whole most probable, that it has been derived from the same stock as the *Procellaria*-group after the special ancestor of the latter was developed, I prefer considering it as simply a highly-specialised form of the Procellariinæ.

The Procellariinæ so defined fall into a number of smaller groups, distinguishable by good characters.

The "Stormy-Petrels" of the genera *Procellaria*, *Cymochorea*, and *Halocyptena*[1] form one such minor group, distinguished by their general small size and coloration, comparatively long tarsi, nearly single nasal aperture, simple triangular tongue, simple *tensor patagii*, peculiar skull with no basipterygoid facets or distinct uncinate bone, entire posterior sternal margin, and little specialised syrinx. *Procellaria* has two cæca, *Cymochorea* one only, and *Halocyptena*, as already mentioned, has them quite absent.

The position of *Pelecanoïdes* has already been fully discussed; it stands quite *per se*, though presumably derived from a stem common to it and the remaining Procellariinæ, which must have diverged from the less specialised one now represented by the *Procellaria*-group.

Prion (with which *Halobæna* is probably to be associated) represents a third minor group, much specialised as regards its peculiarly broad beak with its fringe of lamellæ, whilst in its *tensor patagii* arrangement and syrinx it is not highly developed.

The two genera *Pagodroma* and *Daption* seem very central as regards their relationships, which seem to be with *Prion* (as indicated chiefly by the rudimentary lamellæ of

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[1] *Oceanodroma* also, I have little doubt, belongs to this group.

Daption) on the one hand, and with the Fulmars on the other, *Aeipetes*[1] being the less specialised of these, both as regards its imperfect tracheal septum, and the number of rectrices. The type of syrinx so characteristic of the Fulmars is foreshadowed, as it were, as has been already pointed out (*supra*, p. 35) in that of *Pagodroma*, and all four genera (*Fulmarus*, *Thalassœca*, *Ossifraga*, and *Aeipetes*) agree in the general disposition of the *tensor patagii*, which has no ossicles, in the more or less rudimentary *os uncinatum* in the tendency to anchylosis of the lachrymal and frontal, in the shape of the tongue and of more or less well-developed lamellæ on the bill, and in having four more or less complete, but never deep, sternal emarginations.

Aeipetes is, on the whole, the least specialised of the Fulmarine group in the most limited sense. This includes besides *Thalassœca*, *Fulmarus*, and *Ossifraga*, which last, on account of its great size, peculiar syrinx, and sixteen rectrices, may be considered the culminating point in this direction of the Procellariidæ.

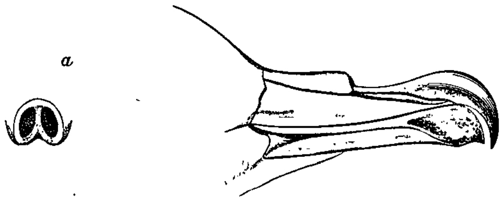

Fig. 31.

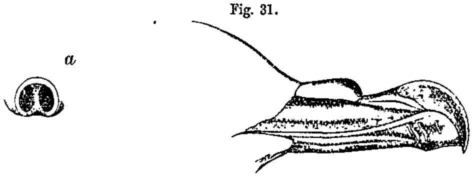

Fig. 32.

Fig. 31.—Beak of *Thalassœca glacialoides*. *a*. The aperture of the nasal tubes, from in front. Natural size.
Fig. 32.—The same parts of *Aeipetes antarcticus*.

The remaining genera, *Œstrelata*, *Puffinus*, *Adamastor*, *Majaqueus*, and *Bulweria* are also apparently closely related to each other, the first and last named being perhaps least so. All agree in having a deeply four-notched sternum, in having well developed uncinate bones, in the possession of one or two accessory wing-ossicles, developed in the termination of the *tensor patagii* tendons, in the spiny tongue (? *Adamastor*), and the palatal armature of spines (? *Adamastor*), and in there never being even indications of lateral lamellæ on the beak.

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[1] I propose to make a genus under this name, for the reception of the *Procellaria antarctica* of Gmelin (Syst. Nat., 1788, vol. i. p. 565), which has usually been considered congeneric with *Thalassœca*, the type (and only representative) of which is *Thalassœca glacialoides*. For the latter bird also was instituted Hombron and Jacquinot's genus *Priocella* (*s.c.*, vol. iii. p. 148). *Aeipetes* is easily distinguishable from *Thalassœca* by the much shorter and stouter bill, and differently shaped nasal tubes, as will be best understood from the accompanying figures (figs. 31, 32). The number of rectrices is also different (twelve as compared to fourteen); the tracheal septum is incomplete, and the structure of the syrinx also quite different (*vide supra*, p. 37). The coloration of the two forms is quite unlike.

Œstrelata differs from its allies in having only a single ulnar ossicle, there being two in all the others.

Puffinus and *Adamastor* are more closely connected together than they are with *Majaqueus*, easily distinguishable by its more normal nostrils, less compressed tarsi, and specialised (? *Adamastor*) syrinx. *Bulweria* is a peculiar form, with no very close ally, and must be regarded as a highly specialised form, as shown in its myological formula being reduced to A.X, and its peculiar cuneate tail. It has no close relationship at all to the Stormy-Petrels, as already pointed out by Dr. Coues,[1] and Garrod.[2]

These views on the classification of the Tubinares may be represented in the annexed diagram (p. 61).

V. THE AFFINITIES OF THE *TUBINARES*.

The Tubinares as a group may be shortly defined as follows:—

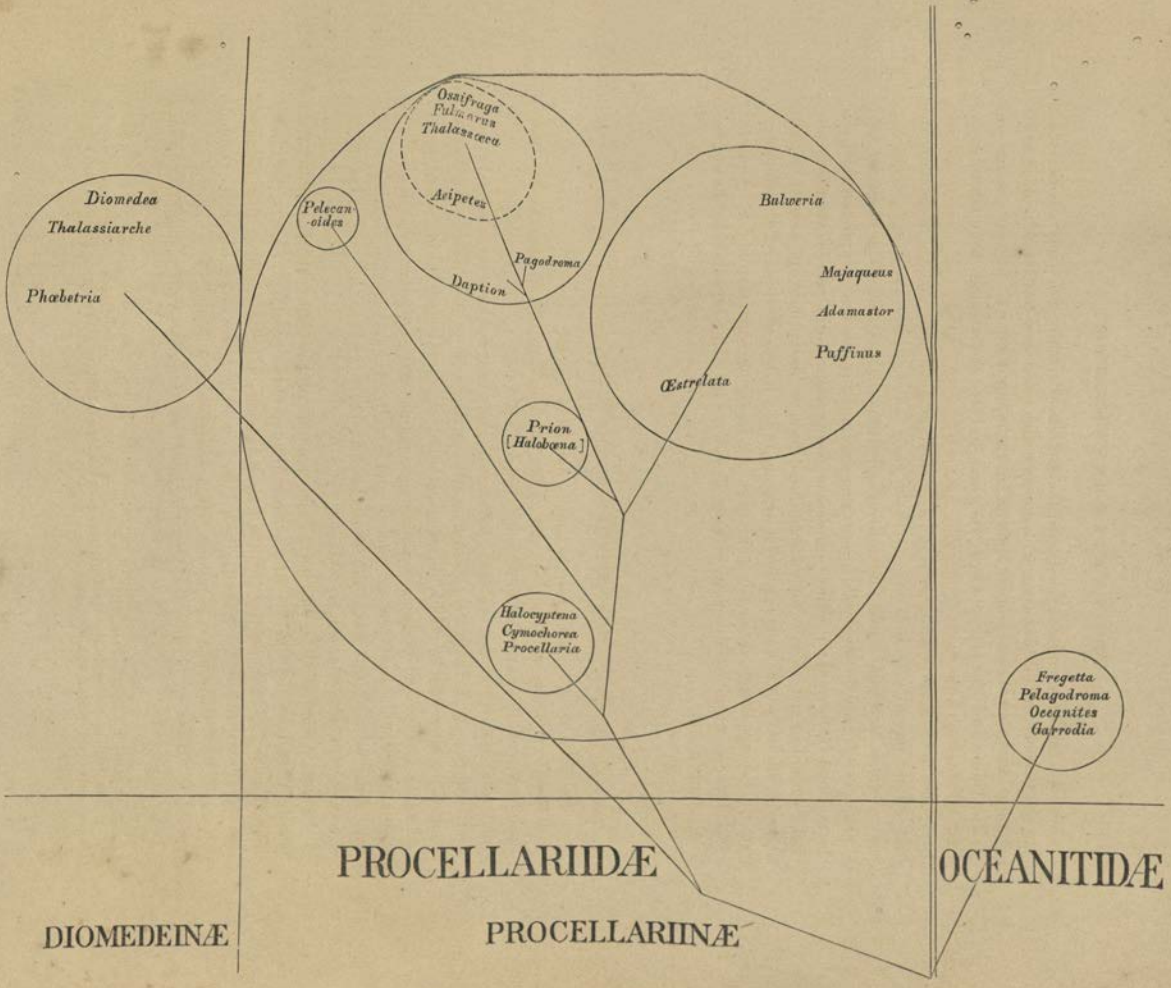
Holorhinal schizognathous birds with a large, broad, depressed, pointed vomer, and truncated mandible; with the anterior toes fully webbed, and the hallux either very small and reduced to one phalanx, or absent; with a tufted oil gland and large supra-orbital glands furrowing the skull; with the external nostrils produced into tubes, usually more or less united together dorsally; with an enormous glandular proventriculus and small gizzard of unusual shape and position, and with the commencing duodenum ascending; with a completely double great pectoral muscle, and a well-developed *pectoralis tertius*; with the femoro-caudal and *semi-tendinosus* muscles always present, and the *ambiens* and accessory femoro-caudal only exceptionally absent.

Some, at least of these characters—the structure of the hallux, the formation of the nostrils[3] and the form of the stomach are quite peculiar to the Tubinares, not being found in any other birds, though of universal presence in these. These features alone would at once suffice to distinguish them from any other Avian order, whilst the combination of other characters is as unique. It is therefore a difficult task to assign to this group a satisfactory position in any arrangement of the class Aves, owing to its much isolated position.

S.c., 1866, p. 139.

[2] Coll. Papers, p. 221.

[3] The Caprimulgine genus *Siphonorhis* (Sclater, Proc. Zool. Soc., 1861, p. 78) perhaps approaches the Tubinares more nearly in this point than any other bird known to me.


Diomedea
Thalassiarche
Phœbetria
Pelecan-oides
Ossifraga
Fulmarus
Thalassœca
Aeipetes
Pagodroma
Daption
Balweria
Majaqueus
Adamastor
Puffinus
Œstrelata
Prion
[Halobæna]
Halocyptena
Cymochorea
Procellaria
Fregetta
Pelagodroma
Oceanites
Garrodia
PROCELLARIIDÆ
OCEANITIDÆ
DIOMEDEINÆ
PROCELLARIINÆ

Most previous writers have considered the Petrels as more or less closely connected with the Gulls (Laridæ), but the grounds for any such collocation are very slight, in my judgment, now that the structure of the two groups is better known.

The Gulls exhibit no trace of any of the characteristic peculiarities of the Petrels,[1] and differ widely from them in the important feature of being schizorhinal.[2] The peculiar disposition in two quite separate layers of the great pectoral muscle in the Tubinares is quite unlike anything seen in the Gulls or their allies, whilst the large *pectoralis tertius* of the Petrels is altogether unrepresented in the Laridæ. The character of the cæca in the two groups is also quite different, and there are no special osteological resemblances between the two groups so far as I can see, for the mere schizognathous character of the palate is, we now know, not necessarily a mark of affinity. The character of the young plumage, the condition of the young birds, and the number, shape, and coloration of the eggs—points on which some stress may be laid in questions of this kind—are totally dissimilar in the two groups, as indeed are the habits of the adult birds themselves, though no doubt both are "web-footed" and more or less pelagic in habit. Such resemblances, however, can hardly be seriously considered as indicating any real affinities.[3]

L'herminier, A. Milne-Edwards, and Huxley have all, in describing various points in the osteology of the Tubinares, pointed out similarities of various kinds between their osseous structure and that of various forms of the Steganopodes, though they still kept them close to the Laridæ. Eyton, on the other hand, places the various Petrels he describes in the family "Pelecanidæ," the Gulls forming a separate family by themselves.

But no one will be prepared, I think, to dispute that the Steganopodes are allied to the Herodiones, including under that name the Storks and Herons, with *Scopus*, only. Thus, on osteological grounds alone, there is sufficient ground for placing the Tubinares in the vicinity of the Steganopodes and Herodiones. And, in fact, neglecting the desmognathous structure of the palate—the taxonomic value of which *per se* is becoming more and more dubious as our knowledge of the structure of birds increases—there is little in the characters assigned to the groups Pelargomorphæ and Dysporomorphæ by Professor Huxley (*l. c.*, p. 461) that is not applicable to the general Petrel type.

The completely double great pectoral muscle is a characteristic only found, as already observed, in the Ciconiidæ, Cathartidæ, the Steganopodes (except *Phalacrocorax*), and the Tubinares, and in all these forms it is associated with short colic cæca of peculiar shape (absent altogether in the Cathartidæ, as in some of the Tubinares), more or less completely webbed feet, tufted oil-gland (except in the Cathartidæ), holorhinal nostrils, a tendency of the palatine bones to unite behind the posterior nares, truncated mandible, broad, strong, well-developed sternum, and strongly curved, well-developed clavicles. These birds also agree together in being " Altrices," the young birds being quite helpless after birth, and requiring to be fed for a long time by their parents—and in generally laying eggs of a white, or nearly white, colour.

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[1] I cannot understand Professor Huxley's remark (Proc. Zool. Soc., 1867, p. 455) that "the Gulls grade insensibly into the Procellariidæ."

[2] *Cf.* Garrod, Coll. Papers, p. 128.

[3] No views regarding the affinities of the Petrels other than that to the Laridæ already discussed, and that to the Ciconiiform birds have, so far as I know, been seriously advanced by ornithological writers, Professor Garrod having abandoned his early idea that the Tubinares were probably related remotely to the Anseres and their allies, (*cf.* Coll. Papers, pp. 220 and 521).

The group so constituted, of which the Ardeidæ and Falconidæ must also be considered as aberrant members,—the first family being closely related to the Ciconiidæ through *Scopus*, whilst the Falconidæ are probably, though much more remotely, connected with the Steganopods,—corresponds to the Ciconiiformes of Garrod,[1] with the addition, as he had already himself suggested,[2] of the Tubinares.

But his earlier definition of that group, in so far as it relates to the absence in it of the accessory femoro-caudal muscle (B), will have to be modified, inasmuch as this muscle is, as shown above, generally present in the Tubinares. These too, differ markedly from the other Ciconiiformes in the well-developed *pectoralis tertius* (very small or absent in the others), in the large size of the vomer, and the non-desmognathism of the palate, though as regards this latter character it has already been pointed out that the Albatrosses are nearly desmognathous, whilst the desmognathism of the Cathartidæ is of a different kind to that prevalent in the other forms concerned.

The two existing groups of Petrels are clearly related to each other so much more nearly than to any other group of birds that it is evident that they must have had a common ancestor that possessed the peculiar features characterising the Tubinares as an order. Such a form may therefore be safely assumed to have had—

1. The characteristic nostrils of the group.
2. The equally characteristic stomach and duodenum.
3. Webbed feet, with a small hallux of a single phalanx.
4. A double great pectoral muscle, and large *pectoralis tertius.*
5. A formula AB.XY, a *gluteus primus* and an *ambiens* muscle.
6. Short colic cæca of characteristic shape.
7. A tufted oil gland, and the pterylosis characteristic of the group.
8. A holorhinal schizognathous skull, with large depressed vomer, great supra-orbital glandular depressions, no basipterygoid facets, and a truncated mandible.
9. A short, broad, deeply-keeled sternum, more or less entire behind, with strong clavicles.
10. A peculiar humerus, and tibia with large cnemial crest.

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[1] Collected Papers, p. 218.

[2] *Loc. cit.*, p. 521.

No living Petrel has this combination of characters; the Oceanitidæ having lost their colic cæca, the Procellariidæ the accessory semi-tendinosus (Y) muscle, and both groups having become specialised in other ways.

Such an ancestral form as here indicated may be supposed to be an early, and in some respects—as shown by the large vomer, schizognathous palate, large third pectoral muscle and formula AB. XY—more primitive form, that diverged from the common stock of the Ciconiiform birds very early, when the latter had only acquired the most prevalent of the characters now existing in the various groups of that sub-order. One branch of this stock has since become greatly modified in the Tubinarial direction, whilst the other branch, loosing "B" and the large vomer, and becoming desmognathous, split up and gave origin, at different times and in different ways, to the remaining families of the group. The definiteness of the characters of these, and the amount of specialisation they show, indicate not only a great antiquity for the whole group, but also the great amount of extinction that has gone on amongst its members in the past, in the process of which nearly all the intermediate and less specialised forms have disappeared.

PLATE I.

Fig. 1. Head of *Oceanites oceanicus.* 1*a* leg and 1*b* foot (from before) of same.

Fig. 2, 2*a*, 2*b*. The same of *Garrodia nereis.*

Fig. 3, 3*a*, 3*b*. The same of *Pelagodroma marina.*

Fig. 4, 4*a*, 4*b*. The same of *Fregetta grallaria.*

Fig. 5, 5*a*, 5*b*. The same of *Procellaria pelagica.*

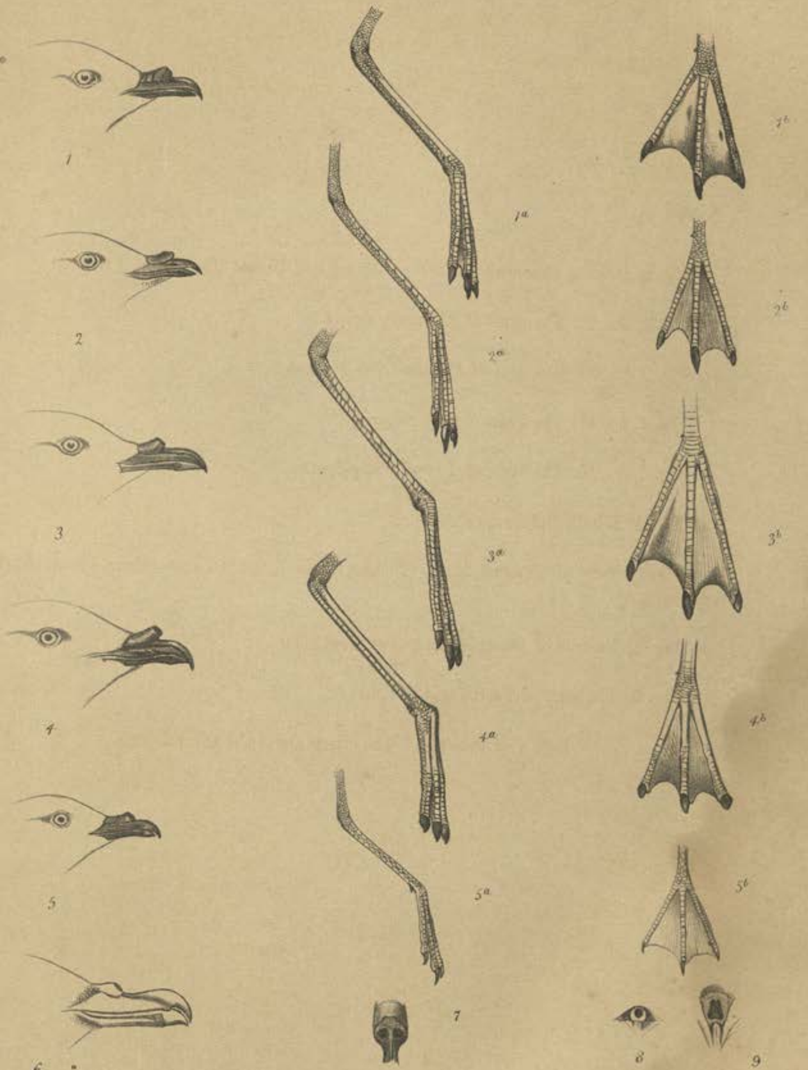
Fig. 6. Bill of *Bulweria columbina.*

Fig. 7. View of external nares of same, from before, to show their two distinct openings.

Fig. 8. Nostrils of *Oceanites oceanicus,* from before.

Fig. 9. The same of *Procellaria pelagica.*

Figs. 7–9 enlarged. The others are of the natural size.



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EXTERNAL CHARACTERS OF PETRELS.
(Oceanitidæ, &c.)

PLATE II.

Fig. 1. Liver, stomach, and duodenal loop of *Majaqueus æquinoctialis*, viewed from in front. L. Liver. *pr.* Proventriculus (the letters are placed on its fundus). *g.* Gizzard. *p.* Pancreas. *g.b.* Gall-bladder. *r.h.d.*, *l.h.d.* Right and left hepatic ducts. *v.p.* Vena portæ. *h.a.* Hepatic artery.

Fig. 2. Outline of stomach, &c., of *Fregetta grallaria.*

Fig. 3. Colic cæca of *Majaqueus æquinoctialis*, enlarged slightly.

Fig. 4. Gizzard of *Fulmarus glacialis* laid open, to show the character of its epithelium.

Fig. 5. Tongue of *Oceanites oceanicus.*

Fig. 6. Tongue of *Pelecanoïdes urinatrix.*

Fig. 7. Tongue of *Diomedea brachyura.*

Fig. 8. Tongue of *Phœbetria fuliginosa.*

Fig. 9. Tongue of *Cymochorea leucorrhoa.*

Fig. 10. Tongue of *Ossifraga gigantea.*

Fig. 11. Tongue of *Aeipetes antarcticus.*

Fig. 12. Tongue of *Daption capensis.*

Fig. 13. Tongue of *Prion banksi.*

Fig. 14. Tongue of *Pagodroma nivea.*

Fig. 15. Tongue of *Œstrelata lessoni.*

Fig. 16. Tongue of *Larus* sp.?

Fig. 17. Tongue of *Majaqueus æquinoctialis.*

Fig. 18. Tongue of *Puffinus brevicauda.*

Fig. 19. Palate of *Oceanites oceanicus*, enlarged. (The line shows the natural size.)

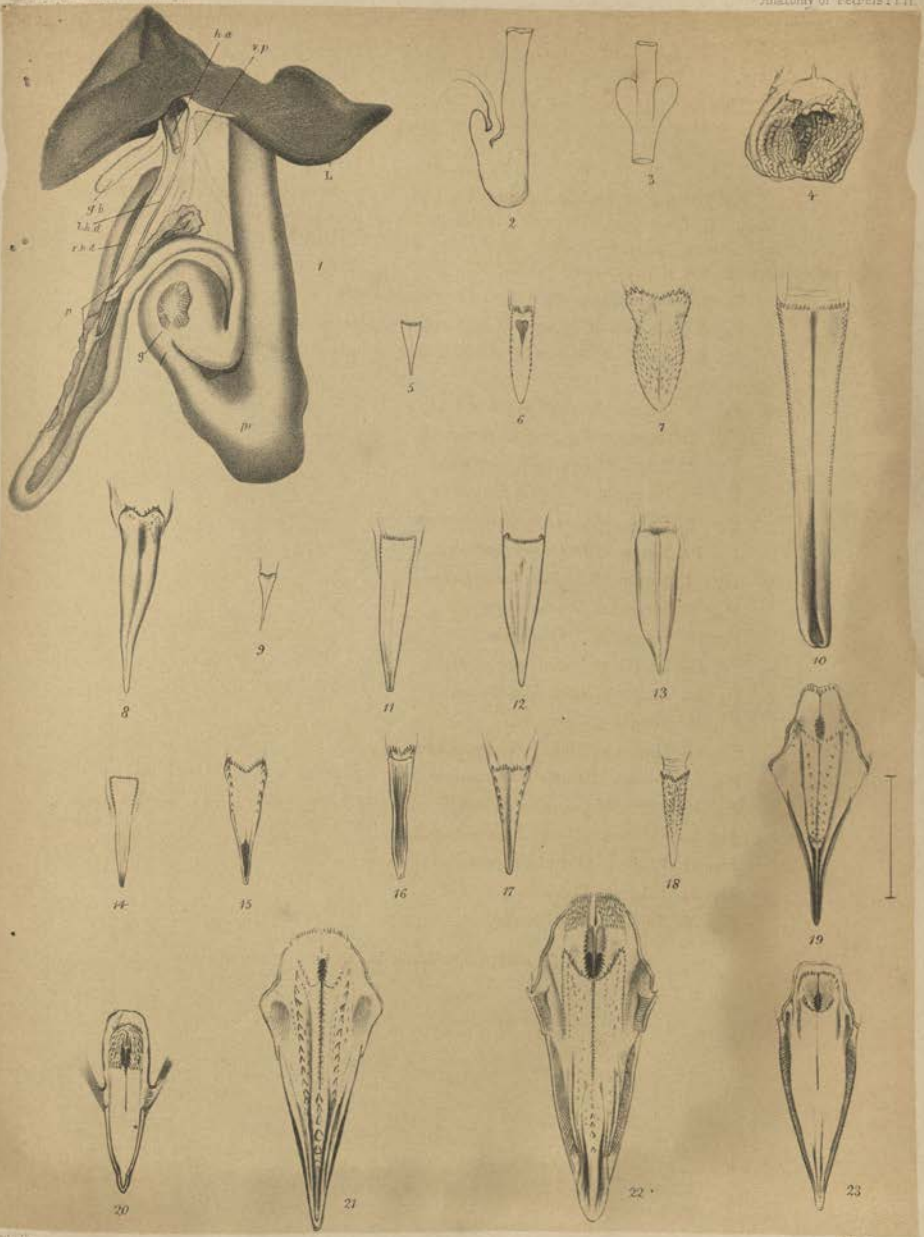
Fig. 20. Palate of *Pelecanoïdes urinatrix.*

Fig. 21. Palate of *Œstrelata lessoni.*

Fig. 22. Palate of *Fulmarus glacialis.*

Fig. 23. Palate of *Prion banksi.*

All the figures, except figs. 3 and 19, are of the natural size.



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ALIMENTARY CANAL, TONGUE, & PALATE OF PETRELS.

PLATE III.

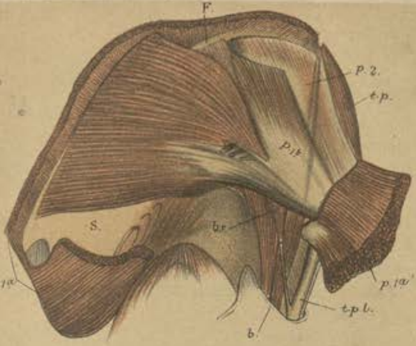
Fig. 1. Left pectoral region of *Majaqueus æquinoctialis*, to show the double *pectoralis major* (*seu primus*) muscle. Its superficial layer (*p.* 1*a*) has been for the most part removed, its cut origin from the sternal crest and furcula (*F.*) being reflected: *p.* 1*a′*, its insertion into the humerus, also cut and reflected. *p.* 1*b*. The deep layer. *p.* 2. Fascia covering the *pectoralis secundus* muscle. *t.p.* Belly of *tensor patagii* muscles. *t.p.l.* Their tendon, joined by *b.s.* (*biceps*-slip) formed by the humeral head of the *biceps humeri* muscle. *b.* Main belly of *biceps* muscle, formed by the coracoidal head. *S.* Body of sternum, bare of muscular fibres.

Fig. 2. Dissection of left pectoral region of *Diomedea brachyura* to show the two layers of the *pectoralis primus* muscle (*p.* 1*a*, *p.* 1*b*), which have been cut and removed in large part, and the compound *pectoralis secundus*. *p.* 2. Its sternal origin; *p.* 2′, its coracoid origin; *p.* 2″, its furcular origin; *p.* 2‴, origin from coraco-furcular membrane (*c.f.m*). *p.* 3. *Pectoralis tertius*. *C.* Coracoid bone. *F.* Furcula, at symphysis. *S.* Sternum. (The line above it shows the limit of origin of the deep layer of the *pectoralis primus*.)

Fig. 3. Dissection of right wing of *Oceanites oceanicus*, to show the peculiar *expansor secundariorum* muscle. *e.s.* Tendinous portion arising from the last remiges (*S.*). *e.s′.* The other moiety, arising from the last scapular feathers (*Sc.*). *p.* 1. *Pectoralis primus* muscle, to which the *expansor secundariorum* is attached. *H.* Humerus. *Pat.* Patagial membrane. *v.n.* Vessels and nerves to wing.

Fig. 4. Left shoulder joint, inner side, of *Ossifraga gigantea*, to show the peculiar *biceps* muscle. *c.* Its coracoid head, continuous below with the belly of the muscle (*b*). *h.* Its humeral head, which forms a *biceps*-slip, joining the tendon of the *tensor patagii* (*t.p*). *p.* 1. Insertions (cut) of the two layers of the *pectoralis primus* muscle. *e. Extensor.* *t. Teres.* *c.b.l. Coraco-brachialis longus.* *c.b.b. Coraco-brachialis brevis.*

Fig. 5. Same parts in *Thalassiarche culminata*. *c.*;*h.* Coracoid and humeral heads of *biceps*, here uniting below into the common tendon of that muscle (*b.*) *b.s.* *Biceps* slip, largely tendinous and joining the *tensor patagii* near the elbow, derived from the coracoid head of the biceps.



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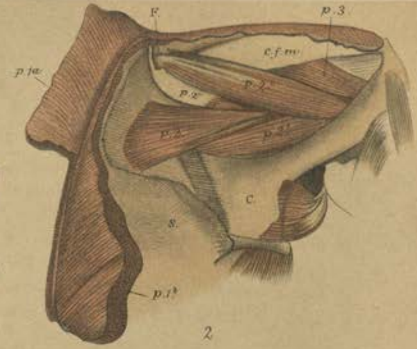

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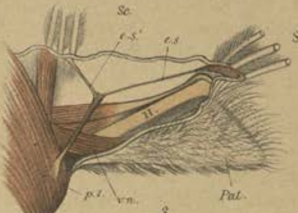

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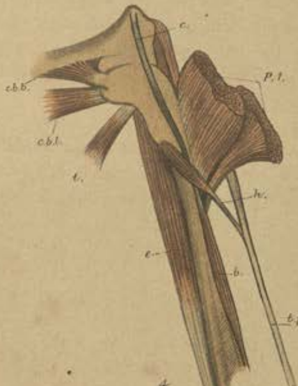

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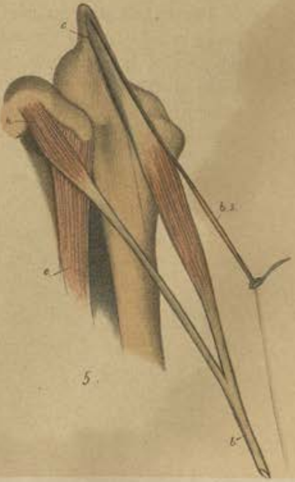

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MYOLOGY OF PETRELS.

Anterior Extremity.

PLATE IV.

Fig. 1. Dissection of right elbow of *Prion desolatus*, to show the disposition of the *tensor patagii* muscles, as seen from above.

Fig. 2. The same in *Œstrelata brevirostis.*

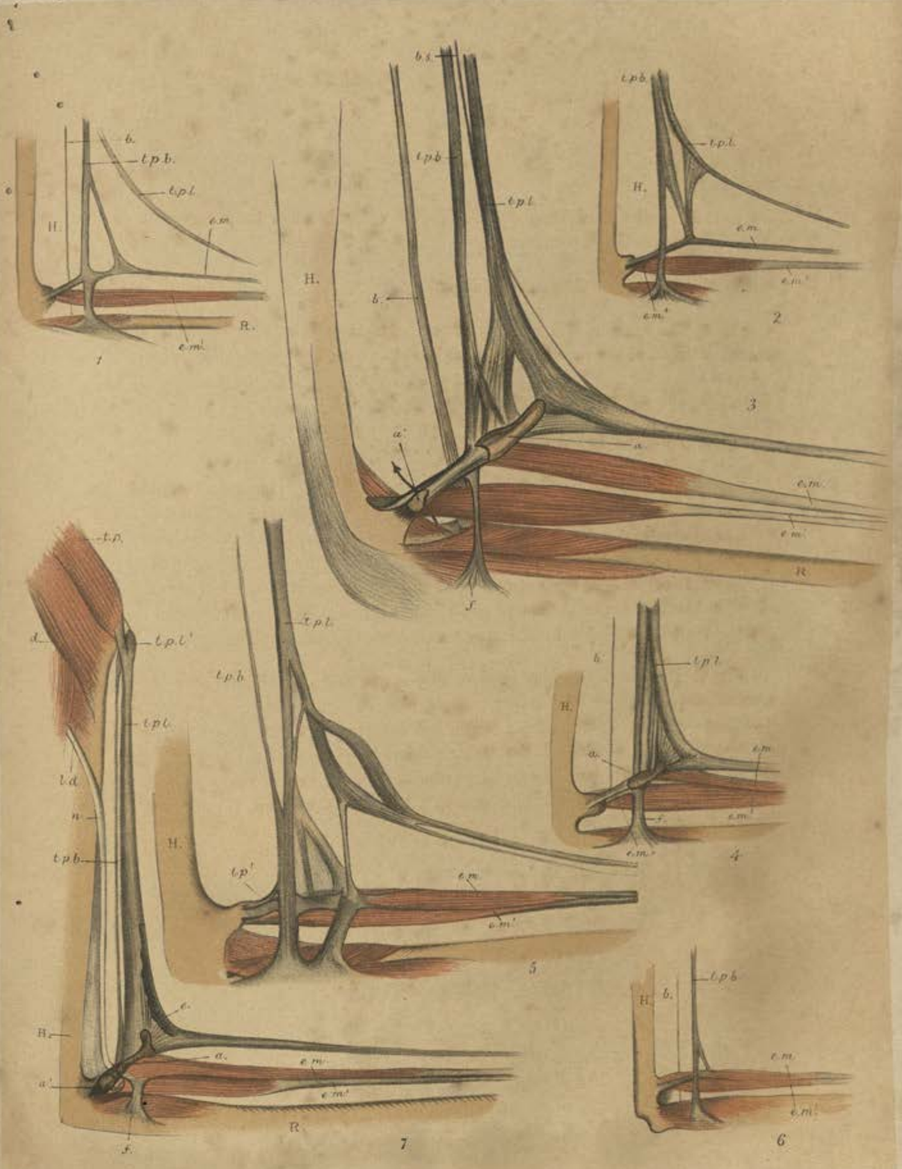
Fig. 3. The same in *Diomedea exulans.* An arrow is passed between the twin tendons of origin of the superficial part of the *extensor metacarpi radialis longior.*

Fig. 4. The same in *Œstrelata lessoni.*

Fig. 5. The same in *Ossifraga gigantea.*

Fig. 6. The same in *Pelecanoïdes urinatrix.* *H.* Humerus. *R.* Radius. *b.* *Biceps* muscle. *t.p.l.* *Tensor patagii longus.* *t.p.b.* *Tensor patagia brevis.* *e.m,e.m'.* Superficial and deep bellies of *extensor metacarpi radialis longior.* *e.m.** Inner of twin tendons of origin of its superficial belly. *b.s.* (in fig. 3). *Biceps* slip. *f.* Fasciculus of patagial tendons continued on to ulnar fascia. *a,a'.* Ossicles developed at origin of the *extensor metacarpi radialis longior.* *t.p.'* (in fig. 5). Special slip from patagial tendons to deep belly of *extensor metacarpi radialis longior.*

Fig. 7. Dissection of right wing of *Majaqueus æquinoctialis*, to show origin and general disposition of the *tensor patagii* muscles. Lettering as above; also *t.p.* Common belly of *tensor patagii longus* and *brevis.* *t.p.l'.* Cushion of elastic tissue, developed in the tendon of the *tensor patagii longus* (*t.p.l.*) at its origin from the humerus. *e.* Elastic pad, developed in the marginal tendon of *tensor patagii longus*, opposite the elbow. *d.* Deltoid muscle. *l.d.* *Latissimusdorsi* (insertion). *n.* Circumflex nerve.



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MYOLOGY OF PETRELS.

Tensor Patagii muscles.

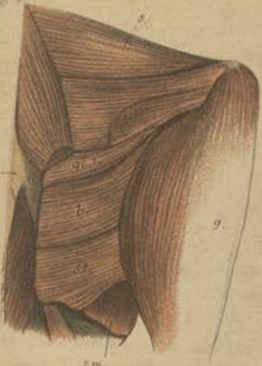
PLATE V.

Fig. 1. View of superficial muscles of right thigh of *Majaqueus æquinoctialis*. *P.* Pelvis. *s. Sartorius. gl.* 1. *Gluteus primus. g. Gastrocnemius. b. Biceps. s.t. Semi-tendinosus. s.m. Semi-membranosus.*

Fig. 2. View of deeper thigh muscles of the same bird; the *gluteus primus, biceps,* and *gastrocnemius* (*g'.*) muscles cut and reflected to show the deeper parts. Lettering as above; also *b'.* cut end of *biceps* passing through the tendinous loop formed by the origin of the *gastrocnemius. f.c.* Femoro-caudal muscle. *a.f.c.* Its accessory head. *o.e. Obturator externus. add.* Adductor muscles. *f.v.* Femoral vein. *sc.* Sciatic nerve and artery. *o.g.* Oil gland.

Fig. 3. The same parts in *Oceanites oceanicus. a.s.t.* Accessory semi-tendinosus muscle. *Pb.* Pubis. *R.* Rectrices.

Fig. 4. Dissection of thigh of *Pelecanoïdes,* to show the absence of the accessory femoro-caudal muscle, and the abnormal course of the femoral vein, this passing over, instead of under, the femoro-caudal muscle. *o.i. Obturator internus. gl.* Glutei.



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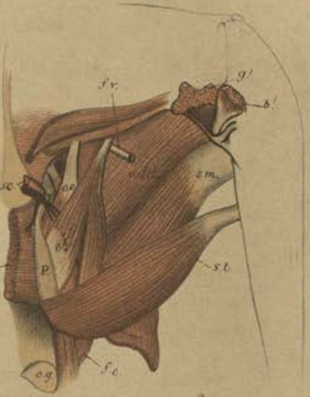

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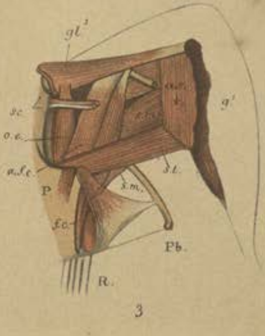

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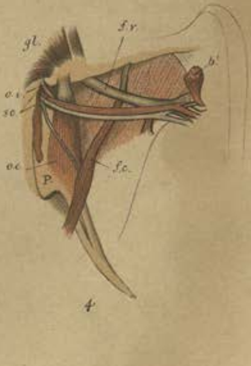

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MYOLOGY OF PETRELS.
Hinder Extremity.

PLATE VI.

Fig. 1. Skull of *Œstrelata lessoni*, viewed from the side. All the figures are of the natural size.

Fig. 2. The same, from below.

Fig. 3. The same, from above.

Fig. 4. Skull of *Prion vittatus*, from below.

Fig. 5. Vomer,—with the ascending plate, anchylosed to it, of the palatine bones,—of *Diomedea exulans*, from the side.

Fig. 6. The same, from above.

Fig. 7. Left uncinate bone ("os crochu" of Reinhardt) from behind, of *Thalassiarche culminata*.

Fig. 8. The same of *Phœbetria fuliginosa*.

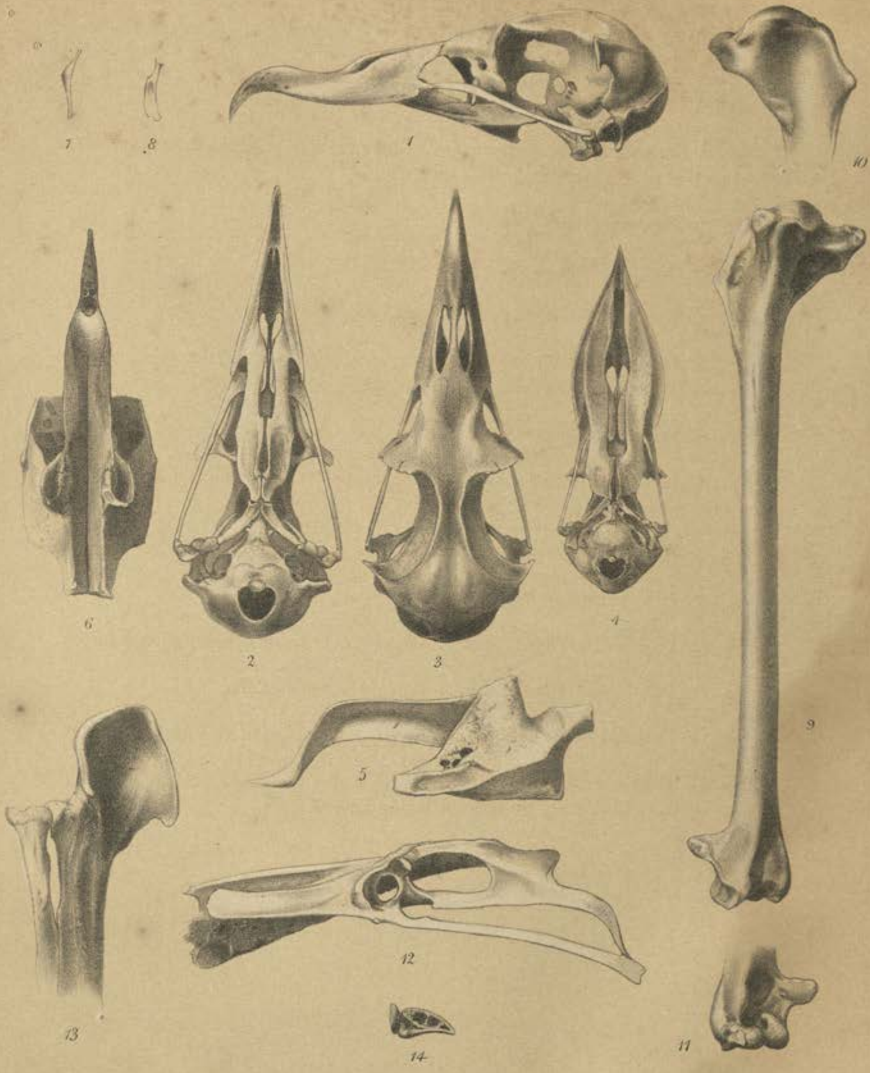
Fig. 9. Left humerus of *Majaqueus æquinoctialis*, from above.

Fig. 10. Proximal, and fig. 11, distal extremities of the same bone, inferior surface.

Fig. 12. Pelvis, seen from the side, of *Majaqueus æquinoctialis*.

Fig. 13. Proximal end of right tibia of *Ossifraga gigantea*, to show the cnemial crest.

Fig. 14. Hallux of *Ossifraga*, with its metatarsal. The single phalanx of which it consists is vertically bisected, to show the hollow interior.



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OSTEOLOGY OF PETRELS.
Skull, Pelvis and Limb-bones.

PLATE VII.

Fig. 1. Sternum, with coracoids and furcula, of *Thalassiarche melanophrys*, from in front. Reduced.

Fig. 2. The same, from the side.

Fig. 3. Sternum and pectoral arch of *Pelecanoïdes urinatrix*, from in front.

Fig. 4. The same, from the side.

Fig. 5. The same, of *Cymochorea leucorrhoa*, from in front.

Fig. 6. The same, from the side.

Fig. 7. The same of *Fregetta melanogastra*, from in front.

Fig. 8. The same, from the side.

Fig. 9. Outline of posterior margin (right side) of sternum of *Ossifraga gigantea*. Reduced.

Fig. 10. The same of *Daption capensis*.

Fig. 11. The same of *Fulmarus glacialis*.

Fig. 12. The same of *Aeipetes antarcticus*.

Fig. 13. The same of *Thalassœca glacialoides*.

Fig. 14. The same of *Prion desolatus*.

Fig. 15. The same of *Pagodroma nivea*.

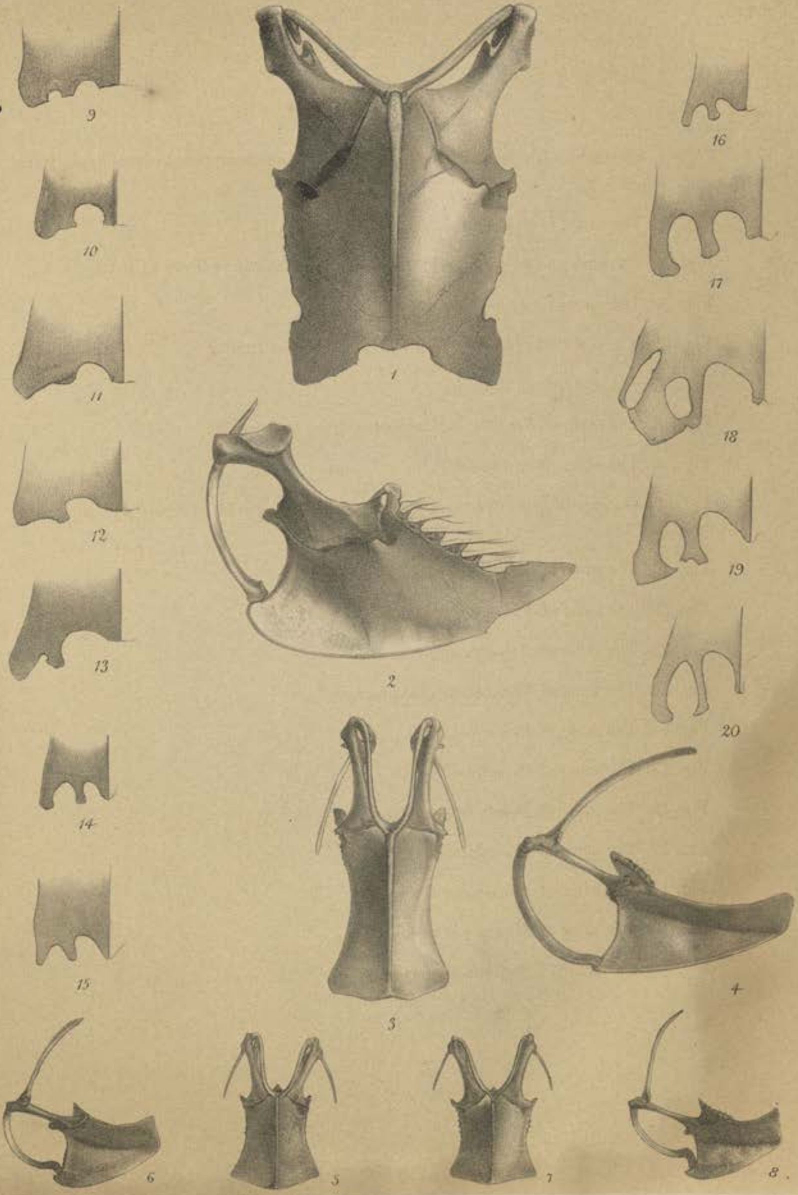
Fig. 16. The same of *Bulweria columbina*.

Fig. 17. The same of *Œstrelata lessoni*.

Fig. 18. The same of *Adamastor cinereus*.

Fig. 19. The same of *Majaqueus æquinoctialis*.

Fig. 20. The same of *Puffinus anglorum*.



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OSTEOLOGY OF PETRELS
Sterna

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the DEEP-SEA MEDUSÆ dredged by H.M.S. Challenger during the years 1873–1876. By Prof. ERNST HÆCKEL.

PREFACE.

THE DEEP-SEA MEDUSÆ form one of the smallest and least important groups of the rich and remarkable deep-sea fauna for whose discovery we are indebted to the voyage of H.M.S. CHALLENGER; the number of the species described does not exceed eighteen, of which half are Craspedotæ and half Acraspedæ. The majority of these eighteen species, however, which represent an equal number of genera, are of great morphological interest, and they, moreover, claim special attention as the first deep-sea inhabitants of this class of animals with which we have become acquainted. I am therefore particularly indebted to Sir Wyville Thomson for most liberally handing over to me for examination the whole of the Medusæ collected by the expedition. To the first large collection of deep-sea Medusæ, sent to me in 1877, I was able to add a few more, which I found incidentally in examining the Radiolaria of the expedition, and in going more minutely over the general collection, during a visit to Edinburgh in 1879. I have especially to thank Mr. John Murray, principal assistant on the civilian staff of the Challenger, for kindly aiding me in this work in every way in his power.

All the eighteen species of deep-sea Medusæ described in this Memoir have already received a brief diagnosis in my System der Medusen published in 1879. Besides these, I had already described two other species, the Æginid, *Æginorhodus rosarius* (System, p. 345, No. 379), and the Cyaneid, *Melusina formosa* (System, p. 535, No. 500).

Unfortunately, however, the fragments of the only specimens which I obtained of these two beautiful Medusæ, proved on closer examination to be so imperfect and so badly preserved, that I was obliged to give up all idea of their further description and illustration. On the other hand, I gained a special advantage in the description of a few other deep-sea Medusæ, whose single specimens from the Challenger collection were also insufficiently preserved, as I was able to complete it by means of material procured elsewhere. I have to thank Professor Steenstrup and Dr. Lütken for several well-preserved specimens of *Ptychogena pinnulata* and *Pectyllis arctica* from the Zoological Museum of Copenhagen, and my friend Mr. Gregor Buccich for several excellent specimens of *Drymonema victoria* from the island of Lesina in Dalmatia. Three species, of each of which the Challenger collection only contained an imperfect fragment, I took myself living with the tow-net, and thus had an opportunity of examining them minutely; *Pectanthis asteroides* from the Mediterranean, *Cunarcha æginoides* from Lanzarote, one of the Canary Islands, and *Polycolpa forskalii* from the Red Sea. Of the majority of the twelve other species I had, unfortunately, only a single specimen at my disposal, and that was often imperfect; still I hope that, with the assistance of the comparative morphology of the most closely allied Medusæ, I have satisfactorily reconstructed their organisation.

It is by no means certain that all the eighteen deep-sea Medusæ described below are constant inhabitants of the deep sea; the method of capture by the tow-net by which such delicate and fragile organisms are often brought from great depths of the sea is still imperfect, and it is probable that the greater number of Medusæ brought up apparently from the greater depths, really swim in shallower water and are only taken in "hauling in" the net. Those Medusæ, on the other hand, may be regarded with greater probability as permanent and characteristic inhabitants of the deep sea, which have either adapted themselves by special modifications of organisation to such a mode of life, or which give evidence by their primitive structure of a remote phylogenetic origin. As such I consider of the nine Craspedotæ described,—first of all the three Pectyllidæ (*Pectyllis, Pectis,* and *Pectanthis*), and secondly *Cunarcha* and *Æginura;* among the nine Acraspedæ, *Tesserantha,* the two large Periphyllidæ (*Periphylla* and *Periphema*), and the two remarkable Ephyridæ (*Nauphanta* and *Atolla*). It appears, however, from the occasional observations of single naturalists, that other Medusæ .species also (especially Charybdeidæ and Rhizostomidæ) inhabit for the most part the bottom of the sea, and pass into considerable depths. We may therefore hope that the following description of the deep-sea Medusæ may be regarded as the first instalment from an interesting region from which we may expect many and important conclusions as to the organisation of the Medusæ.

It will be seen from the systematic survey on p. 141 that altogether eight orders of this class, distinguished by me in my System der Medusen, 1879, are represented among the eighteen deep-sea Medusæ of the Challenger expedition. Of these one species (*Thamnostylus*, Pl. I.) belongs to Order I. Anthomedusæ; one species (*Ptychogena*, Pl. II.) to Order II. Leptomedusæ; three species (*Pectyllis*, *Pectis*, and *Pectanthis*, Pls. III.-VIII.) to Order III. Trachomedusæ; four species (*Cunarcha*, *Polycolpa*, *Pegantha*, *Æginura*, Pls. IX.-XIV.), to Order IV. Narcomedusæ; two species (*Tesserantha* and *Lucernaria*, Pls. XV.-XVII.) to Order V. Stauromedusæ; two species (*Periphylla* and *Periphema*, Pls. XVIII.-XXV.) to Order VI. Peromedusæ; one species (*Charybdea*, Pl. XXVI.) to Order VII. Cubomedusæ; four species (*Nauphanta*, *Atolla*, *Drymonema*, *Leonura*, Pls. XXVII.-XXXII.) to Order VIII. Discomedusæ. Thus thirteen of the thirty-two families which I defined in my System der Medusen, 1879, are represented here (comp. p. 141).

A tabular view of the chorology of these Medusæ is given on p. 142. Their geographical distribution extends throughout the whole of the great oceans; on the whole, there are eight species in the Atlantic-Mediterranean region, and ten species in the Indo-Pacific region. Of the eight former species seven belong to the northern, one to the southern half of the Atlantic Ocean (two of which are also found in the Mediterranean). Of the remaining ten species, two belong to the north half, three to the southern half of the Pacific Ocean, and five to the Antarctic part of the Indian Ocean. One of the latter is also found in the south-western part of the Atlantic.

With regard to the bathymetrical distribution, it will be seen from the table on p. 142 that seven species were taken in depths from 80 to 600 fathoms, six species in depths from 1100 to 1600 fathoms, and five species in depths from 2000 to 2200 fathoms. For reasons already stated, these depths must (partly at least) be considered more or less approximate.

With regard to the figures of the deep-sea Medusæ in the thirty-two plates appended to this Memoir, it is of course impossible, from the imperfect state of preservation of the spirit specimens, to expect that they should be absolutely true to nature. I rather considered it my duty here, as in those figures in my System der Medusen which were drawn from spirit specimens, to take advantage of my knowledge of the forms of the living Medusæ, to reconstruct the most probable approximate image of the living forms. I was greatly assisted in my efforts in this direction by the skilful hand of my lithographer, Mr. Adolf Giltsch. I am also greatly indebted to my friend Dr Reinhold Teüscher for preparing a large number of excellent microscopic sections. This Memoir has been translated into English by Miss Nellie Maclagan, and I thank her for the kind care with which she has executed a difficult task.

The many new morphological facts, furnished by close examination of the deep-sea Medusæ, are not only of special interest in themselves, but are, for the most part, of general interest for deciphering the comparative anatomy of the whole class; this is true, for example, of the Pectyllidæ and Peganthidæ among the Craspedotæ, and of the Periphyllidæ and Ephyridæ, among the Acraspedæ. I therefore considered it convenient to preface the special anatomical description of the eighteen deep-sea Medusæ by a short article on the Organisation of the Medusæ, which serves in a certain measure as a morphological introduction to the former, and at the same time as a preliminary Scheme of a comparative Morphology of the Medusæ.

ERNST HÆCKEL.

JENA, 14*th September* 1881.

THE ORGANISATION OF THE MEDUSÆ.

Sketch of a Comparative Morphology of the Medusæ as an Introduction to the Description of the Deep-sea Medusæ of the Challenger Expedition.

I. GENERAL MORPHOLOGY OF THE MEDUSÆ.

§ 1. Definition of the Medusæ. Medusæ are Cnidariæ or Acalephæ with a gelatinous, radially constructed, concave-convex umbrella, whose vertical axis is the principal axis of the single persona; with swimming muscles on the concave oral side of the umbrella; nerve centres and organs of sense on the peripheric margin of the umbrella; with radial processes (canals or pouches) of the central gastral cavity, and a simple (seldom multiple) oral opening at the oral pole of the principal axis; also with genitalia in the subumbral wall of the gastrovascular system (comp. System der Medusen, 1879, p. 21, &c.). Medusæ are distinguished from the other classes of Acalephæ or Cnidariæ (Polyps, Corals, Siphonophora, Ctenophora) by the following class characters: the mature, completely developed Medusa appears as a single persona (not united in numbers in a colony), which usually swims freely in the water, seldom crawls, still more rarely is fastened to the bottom; (nearly all Medusæ live in the sea, only a few in fresh-water). The principal mass of the Medusa body (by volume and weight) forms a concave-convex, watery gelatinous body, the umbrella. This serves as the special swimming organ; a vertical principal axis and two or more horizontal transverse axes (with twice as many radial axes) are always the standard for its pyramidal base form. The convex outer surface of the umbrella (exumbrella) does not generally bear special organs, whilst the concave inner surface (subumbrella) is always overlaid with a muscular plate, which, as the most important organ of motion, deepens and narrows the umbrella cavity by its contraction, and thereby expels the water from it. The most important organs of sensation, the nerve centres, and differentiated organs of sense, and generally the tentacles also, lie on the umbrella margin (where the exumbrella and the subumbrella are contiguous). The organs of nutrition are formed by a radial gastrovascular system which extends over the subumbrella, and is composed of a central principal intestine and a peripheric coronal intestine. The principal intestine (in the centre of the subumbrella) forms a simple gastral cavity, which often projects below like a tube and opens at the oral pole of the principal axis by a simple (seldom multiple) mouth. The coronal intestine (in the periphery of the subumbrella) is composed of four or more radial processes of the central stomach, which sometimes take the form of broad pouches, sometimes of narrow canals. The organs of reproduction are always simple reproductive glands (genitalia) and are always developed in the lower (subumbral) wall of the gastrovascular system, sometimes from its endoderm, sometimes from its ectoderm. Nearly all Medusæ are gonochoristic, only a few hermaphrodite. As regards the phylogeny of the Medusæ, their comparative anatomy and ontogeny points out the class of Polyps as their original ancestral group.

§ 2. Definition of the Polyp. The class of the Polyps, from which the class of Medusæ are phylogenetically derived, and which, therefore, furnishes the key to our morphological knowledge of them, is at the same time the common ancestral group of all Cnidariæ. At present the fresh-water Polyp (Hydra), and the closely allied genera *Clava*, *Coryne*, &c., must be considered their simplest and most primitive representatives. Their developed organism is immediately allied to that of Gastrula (phylogenetically Gastræa), and has the same simple primitive intestine with primitive mouth, whose wall is formed from the two primary germinal layers. The Polyp is chiefly distinguished from the Gastrula by beginning histological differentiation of the two primary germinal layers, and also by the fact that the aboral pole of the principal axis serves as a peduncle for adhesion, whilst a corona of feelers or tentacles is developed round the mouth at its oral pole. This corona of tentacles forms the boundary between the strongly-arched aboral part of the body (cup, "calyx") and the flat or even depressed oral part (oral disk, "peristomium").

§ 3. Medusa and Polyp. The most essential difference between the organisation of the Medusa and the Polyp consists in the formation of the characterstic swimming organ of the former, the umbrella, and of the cathamma or partial fusions between the aboral wall of the cup ("calyx") and the oral disk ("peristomium"), by means of which the peripheric part of the simple gastral cavity is divided into radial pouches or canals, which regularly surround its simple central space. The central gastral cavity of the Medusa does not therefore correspond to the whole simple gastral space of the Polyps (or to the primitive intestine of the Gastræa) but only to the central part of it, whilst on the other hand its peripheric part is homologous with the radial (usually four-rayed) coronal intestine of the Medusa ("pouch corona or canal corona"). The central oral opening is identical in both animal classes, arising from the primitive mouth of the Gastrula, and when it is prolonged in the Polyps into an oral cone or proboscis, the latter corresponds to the freely projecting œsophagus or oral peduncle of many Medusæ. The peristomium of the Polyps (or the slightly concave oral disk) is homologous with the "subumbrella" of the Medusa (or the more strongly depressed lower surface of the umbrella). In the same way the convex outer surface or the dorsal cup-wall (calyx) of the Polyp corresponds to the more depressed dorsal wall or "exumbrella" of the Medusa. The cup-margin of the Polyps (with the insertion of the corona of tentacles) is therefore homologous with the umbrella margin of the Medusa, but in the latter, differentiated organs of sense are developed beside or from the tentacles, whilst this is not the case in the former. As regards histological differentiation, the older and lower Polyp form remains far behind the younger and higher Medusa form. The latter has arisen from the former by adaptation to a swimming mode of life, and has thereby become perfected.

§ 4. Craspedotæ and Acraspedæ (System, p. xxiv. 1, 361). The class of the Medusæ is divided into two different sections or sub-classes, Craspedotæ and Acraspedæ. Both sub-classes form natural principal groups, differing essentially and thoroughly from one another in important conditions of organisation. Although single groups in both sections are so like that they may be confounded together, and, in fact, have often been so, yet the two principal groups differ fundamentally, and have probably arisen quite independently of one another from two different groups of polyps; their most important differences are best seen from the following tables:—

I. CRASPEDOTÆ OR HYDROMEDUSÆ.	II. ACRASPEDÆ OR SCYPHOMEDUSÆ.
A. Gastral space, without gastral filaments or phacelli (Aphacellæ).	A. Gastral space with gastral filaments or phacelli (Phacellotæ).
B. Genitalia ectodermal (sexual products of the outer germinal layer) (Cryptocarpæ).	B. Genitalia endodermal (sexual products of the inner germinal layer) (Phanerocarpæ).
C. Umbrella margin with true velum, without true marginal lobes (Craspedotæ).	C. Umbrella margin without true velum, with true marginal lobes (Acraspedæ).
D. Organs of sense usually simple, without protective plate (Gymnophthalmæ).	D. Organs of sense usually composite, with special protective plate (Steganophthalmæ).
E. Marginal nerve ring double and centralised (Cycloneuræ).	E. Marginal nerve ring simple, usually non-centralised (Toponeuræ).
F. Descent from Hydropolyps, or Polyps without gastral tæniola (Hydromedusæ).	F. Descent from Scyphopolyps, or Polyps with gastral tæniola (Scyphomedusæ).

§ 5. Hydropolyps and Scyphopolyps. The two sections of the class Medusæ correspond to two different sections of the Polyp class, Hydropolyps and Scyphopolyps. The lower more simply constructed Hydropolyps have retained a perfectly simple gastral space with smooth inner surface (primitive intestine or "archigaster" of the *Gastræa*). The higher and more perfect Scyphopolyps are distinguished from the Hydropolyps by four interradial longitudinal swellings or gastral ridges ("tæniola") being developed on the inner surface of the gastral cavity, by which their peripheric part is consequently divided into four broad perradial niches or pouches ("antra gastralia"). The Hydromedusæ or Craspedotæ, as well as the classes of Siphonophoræ, and Ctenophoræ derived from them, are descended from the Hydropolyps (*Hydra*, *Clava*, &c.); the gastral filaments are wanting in all these Cnidariæ. The Scyphomedusæ or Acraspedæ, as well as the class of Corals or Anthozoa are descended from the Scyphopolyps (*Scyphostoma, Spongicola,* &c); both these classes have gastral filaments or mesenteric filaments, which have arisen from the tæniola of the Scyphopolyps.

§ 6. Polyphyletic origin of the Medusæ. That the class of Medusæ belongs to the polyphyletic classes of animals is now a phylogenetic hypothesis, which may be brought forward as a probability bordering upon certainty, although, on the one hand, the characteristic structure of the Medusæ appears so uniquely organised that they are most suitably placed as a separate class in the system of the animal kingdom, yet, on the other hand, it by no means follows that they are all derived from a single common ancestral form, which already possessed the form of the Medusæ. It is much more probable that the two sub-classes, or sections of this class, the Craspedotæ and Acraspedæ, are of separate origin, and are descended from groups of Polyps, which have developed into Medusæ, independently of one another. A strong support to this hypothesis is, that the Scyphopolyps, the ancestral form of the Acraspedæ (*Scyphostoma, Stephanoscyphus,* &c.), already possess the four important interradial tæniola or gastral longitudinal ridges from which the four characteristic groups of filaments are developed in all Acraspedæ (or Scyphomedusæ). On the other hand, the characteristic groups of filaments are wanting in the Craspedotæ (or Hydromedusæ) as the typical four interradial tæniola are wanting in their ancestral form, the Hydropolyps. Moreover, the reproductive organs originate in the Craspedotæ (as in most Hydropolyps) from the ectoderm and in the Acraspedæ (as in the Scyphopolyps and Corals) from the endoderm. As regards the two sections or sub-classes, the Craspedotæ are more probably of monophyletic origin, the Acraspedæ of polyphyletic.

§ 7. Orders of the Craspedotæ (System, pp. 2, 233, 360). The section of the Craspedotæ or Hydromedusæ is divided into two sub-sections and four orders. The two sub-sections, Leptolinæ and Trachylinæ, are thoroughly and pre-eminently distinguished from one another by the absence or presence of the cordyli or tentacular "auditory clubs." These are modified acoustic tentacles, consisting of a solid axis of chordal endodermal cells, of which the last (distal) contains one or more otolites; their ectodermal epithelium bears stiff auditory bristles. The first sub-section (or Acordyliæ) has no auditory clubs; it has, in fact, either no auditory organs or only "velar auditory vesicles" (marginal vesicles on the velum with ectodermal otolites) which are quite different from the cordyli, and occur in no other group. Moreover in the Leptolinæ, the tentacles are usually hollow, very movable contractile filaments, and their velum is delicate and thin. The second sub-section, the Trachylinæ (or Cordyliotæ), on the other hand, invariably bear true cordyli or auditory clubs with endodermal otolites on the margin of the velum; their tentacles are, moreover, usually solid, tolerably stiff, and slightly contractile filaments, and their velum is thick and compact. The Leptolinæ mostly develop indirectly (by metagenesis), the Trachylinæ mostly directly (by hypogenesis). In both sub-sections there is an order with gastral genitalia (Anthomedusæ, Narcomedusæ), and an order with vascular genitalia (Leptomedusæ, Trachomedusæ). Those differences are clearly shown by the following tables:—

§ 8. Survey of the two sections of Craspedotæ.

LEPTOLINÆ (Acordyliæ).	TRACHYLINÆ (Cordyliotæ).
Craspedotæ without auditory clubs or cordyli, with very movable and extensible tentacles, which are usually hollow.	Craspedotæ with auditory clubs or cordyli, with stiff and slightly extensible tentacles, which are usually solid.
Order I. ANTHOMEDUSÆ, Pl. I. (System, p. 3, taf. i.–vii.) Genitalia gastral (reproductive organs originally in the subumbral wall of the stomach), descent from Tubularia polyps.	Order III. TRACHOMEDUSÆ, Pls. III.–VIII. (System, p. 234, taf. xvi.–xviii.) Genitalia vascular (reproductive organs originally in the subumbral wall of the radial canals), usually without peronia on the umbrella margin, never with peronial canals.
Order II. LEPTOMEDUSÆ, Pl. II. (System, p. 3, taf. viii.–xv.) Genitalia vascular (reproductive organs originally in the subumbral wall of the radial canals), descent from Campanularia polyps.	Order IV. NARCOMEDUSÆ, Pls. IX.–XIV. (System, p. 299, taf. xix.–xx.) Genitalia gastral (reproductive organs originally in the subumbral wall of the stomach), peronia on the umbrella margin, usually with developed peronial canals.

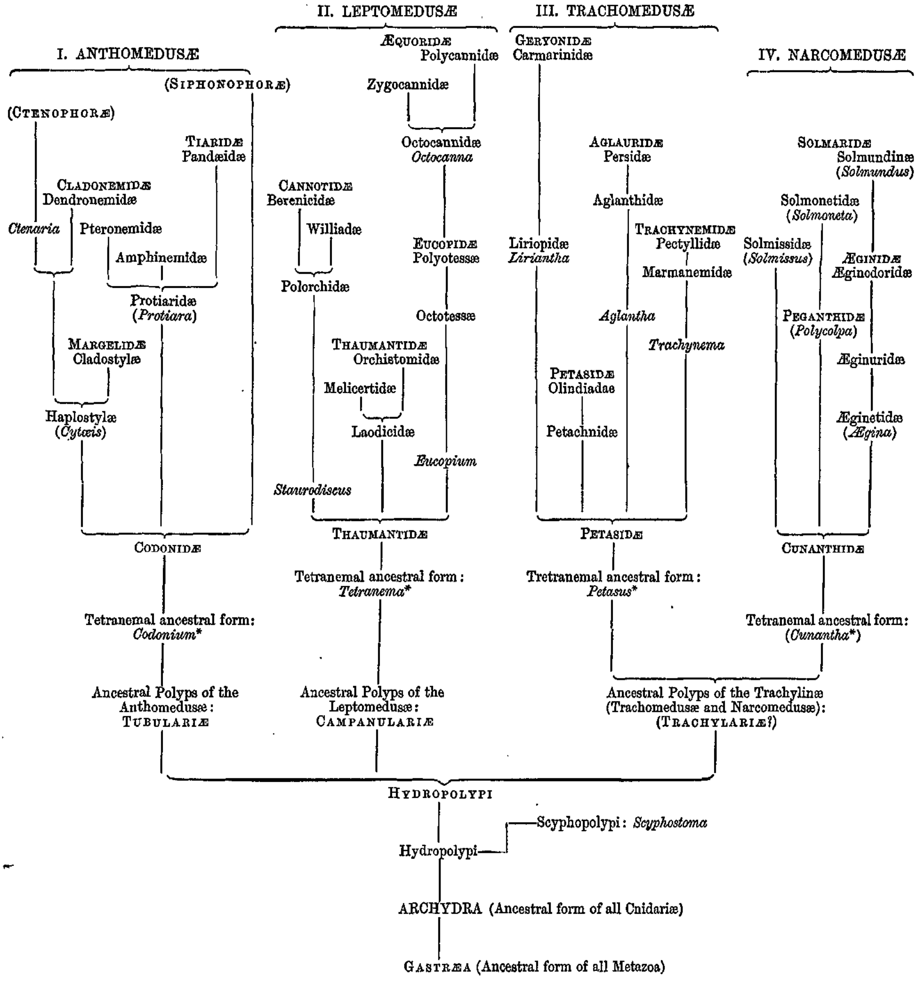
§ 9. Orders of the Acraspedæ (System, pp. 362, 449, 632). The section of the Acraspedæ or Scyphomedusæ is divided into two sub-sections and four orders. The first, older and lower sub-section, the Tesseroniæ (or Tetraperiæ), has a highly arched, usually conical umbrella, and on its subumbral side four large perradial gastral pouches, separated by four interradial septa or cathamma, in whose subumbral wall the genitalia are developed. The second, younger and higher sub-section, the Ephyroniæ (or Octoperiæ) has, on the contrary, a depressed, usually discoid umbrella, and on its subumbral side, a very wide, flat gastral cavity, into which the four original perradial pouches have been merged, and in whose subumbral wall the genitalia are therefore developed; the four interradial septa or cathamma have undergone retrograde formation, and are mostly lost. A further distinction between the two sub-sections lies in the number of their characteristic sense clubs or rhopalia. All Ephyronia or Discomedusæ have eight or more sense clubs (four perradial, four interradial, often several accessory), whilst the Tesseroniæ have only four sense clubs, or none at all. Of the three orders of the Tesseroniæ, the Peromedusæ have four interradial rhopalia, the Cubomedusæ four perradial, and the Stauromedusæ no rhopalia (tentacles instead). These differences are shown by the following tables:—

§ 10. Survey of the two sections of the Acraspedæ.

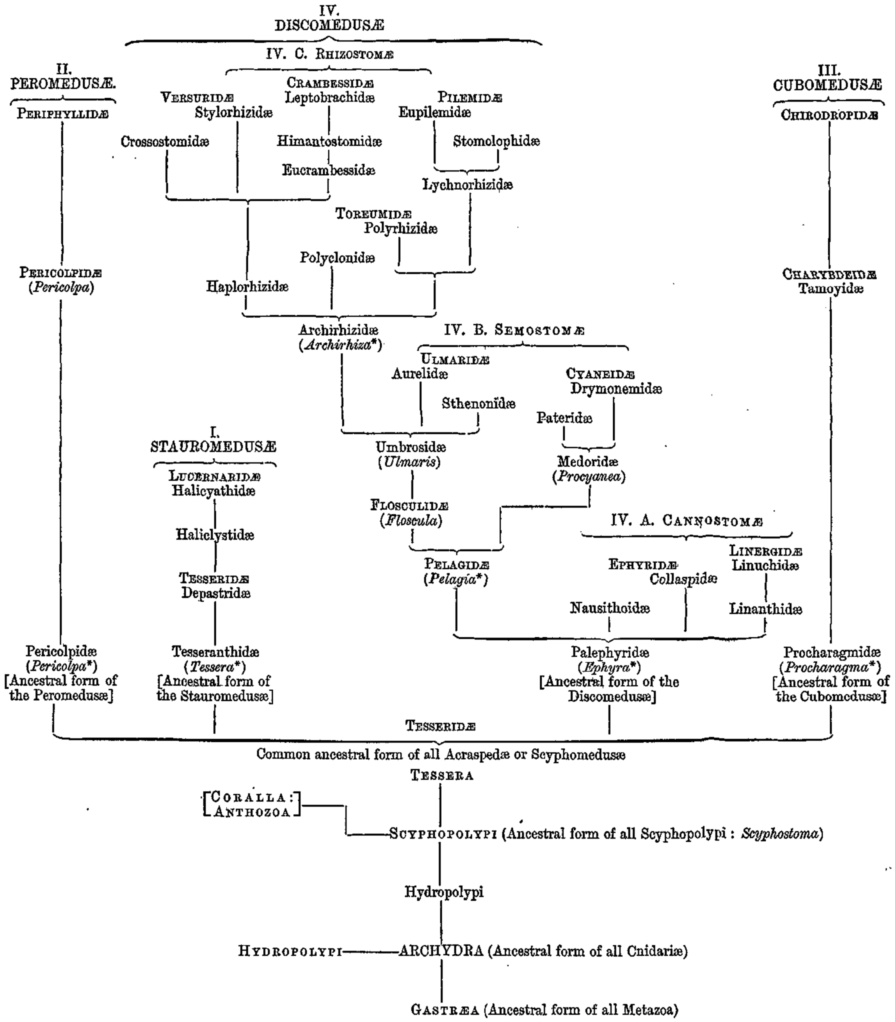
Tesseroniæ (Tetraperiæ).	Ephyroniæ (Octoperiæ).
Acraspedæ without sense clubs, or with four sense clubs (rhopalia). Umbrella usually highly arched, conical; four perradial gastral pouches large, separated by developed cathammal septa.	Acraspedæ with eight or more (up to thirty-two) sense clubs (rhopalia). Umbrella usually depressed, discoid; four perradial pouches small, usually become part of the central stomach, by dissolution of the cathammal septa.
Order I. Stauromedusæ, Pls. XV.–XVII. (System, p. 363, taf. xxi.–xxii.) No rhopalia; simple tentacles instead. Order II. Peromedusæ, Pls. XVIII.–XXV. (System, p. 396, taf. xxiii., xxiv.) Four interradial rhopalia and four perradial tentacles between (often eight adradial tentacles in addition). Order III. Cubomedusæ, Pl. XXVI. (System, p. 423, taf. xxv., xxvi.) Four perradial rhopalia and four interradial tentacles or bunches of tentacles between.	Order IV. Discomedusæ, Pls. XXVII.–XXXII. (System, p. 450, taf. xxvii.–xl.) Eight rhopalia or more, four perradial, and four interradial (sometimes also several accessory). Sub-Order I. Cannostomæ. Œsophagus simple, without free oral arms. Tentacles usually short and solid. Sub-Order II. Semostomæ. Œsophagus cleft into four large perradial, folded oral arms. Tentacles usually long and hollow. Sub-Order III. Rhizostomæ. Œsophagus represented by eight adradial dice-shaped oral arms with numerous funnel openings. Central mouth fused. No tentacles.

§ 11. Polyphyletic origin of the Craspedotæ. The section Craspedotæ or Hydromedusæ is probably a polyphyletic animal group; several different groups of Craspedotæ having arisen independently of one another from several different groups of Hydropolyps. This is corroborated by the fact that all Anthomedusæ are descended from Tubularian Polyps, all Leptomedusæ from Campanularian Polyps. The phyletic divergence of these two groups of polyps is probably very much older than the origin of the two corresponding orders of Medusæ. The Trachylinæ or Cordyliotæ seem to form a third independent group of this section, the Trachomedusæ and Narcomedusæ. But these two orders may also have originated independently of each other. The monophyletic origin of all forms within the four orders of Craspedotæ from a single common ancestral form, though not certain, is still extremely probable (System, p. 359).

§ 12. Hypothetical Ancestral Tree of the Craspedotæ (Polyphyletic).



§ 13. Hypothetical Ancestral Tree of the Acraspedæ (Monophyletic).



§ 14. Monophyletic origin of the Acraspedæ. Whilst the section of the Craspedotæ is probably of polyphyletic origin, and their chief groups have arisen independently of one another, the conditions of relationship among the Acraspedæ or Scyphomedusæ is, on the contrary, so close that the monophyletic origin of these sections may be admitted with the greatest probability. The existing Tessera has even retained a very old primordial form, which has the same significance for the section of the Acraspedæ as Hydra has for the whole tribe of the Cnidaria. The order of Stauromedusæ in which the sense clubs or rhopalia are completely wanting, is developed first of all from Tessera. The two orders of Peromedusæ and Cubomedusæ, spring as two diverging principal branches from the ancestral group of the Stauromedusæ; in the former the four interradial tentacles are transformed into sense clubs or rhopalia; in the latter, on the contrary, it is the four perradial tentacles. The fourth order of Acraspedæ, the extensive group of the Discomedusæ, is distinguished by the fact that all the eight principal tentacles are transformed into rhopalia; it has probably originated from the Stauromedusæ or Cubomedusæ, perhaps rather from the Peromedusæ. The Cannostomæ form the ancestral group among the Discomedusæ; the Semostomæ have probably arisen later from these, and the Rhizostomæ still later from the Semostomæ (System, p. 450).

§ 15. Ontogenesis of the Medusæ. The individual development or ontogenesis, which, according to the biogenetic fundamental law, affords us the surest explanation of the phylogenesis or the original development of the tribe, appears in the Medusæ in two distinct principal forms, as metagenesis and hypogenesis. Metagenesis (or indirect development) includes the alternation of generations of the Medusæ; the Medusa is formed here asexually by gemmation from a sessile polyp; and the ova of the free-swimming Medusæ do not again develop into Medusa, but into the Polyp, which functions as bud-bearing "nurse." On the other hand, hypogenesis (or direct development) of the Medusa consists of the immediate development of the Medusæ from the ova of the Medusæ; the intermediate stage of the Polyp-nurse is wanting. As then the comparative anatomy indubitably shows that the wandering, more highly developed Medusa form is to be derived phylogenetically from the sessile Polyp form, we must consider the metagenesis of the Medusæ as their original or palingenetic mode of development, but their hypogenesis as the modified, shortened, and simplified cenogenetic form of gemmation. It is the metagenesis, not the hypogenesis, which repeats in epitome the method of historical development.

§ 16. Metagenesis or indirect development. The alternation of generations or metagenesis of Medusæ must be considered their original form of generation or primary mode of development,—their palingenesis; it appears in different forms in the two sections of the class. The Craspedotæ originate from Hydropolyps by lateral gemmation, the Acraspedæ from Scyphopolyps by terminal gemmation. These two forms of alternation of generations are not referable to one another, and have arisen independently of one another. Among the Craspedotæ, alternation of generation is the usual form of development of the Leptolinæ (or Acordyliæ), and the Polyp-nurses of the Anthomedusæ are Tubularian Polyps, whilst the Polyp-nurses of the Leptomedusæ are Campanularian Polyps. On the other hand, metagenesis only occurs rarely among the Trachylinæ (or Cordyliotæ) (*Lovenella clausa* is perhaps the Campanularian nurse of a Trachomedusa (?)—System, p. 653). Among the Acraspedæ, ontogenesis of the Tesseroniæ is still unknown. Alternation of generations seems to be the usual form of development in the *Ephyroniæ*. The peculiar form of terminal gemmation, by which the Discomedusa is developed from the Scyphopolyp nurse, is, however, essentially different from the lateral gemmation by which the Craspedotæ are developed from the Hydropolyp nurse.

§ 17. Hypogenesis or direct development. Direct development without alternation of generations, which in one word we call hypogenesis, must not be regarded as the original form of generation in the Medusæ, but as a secondary, shortened and simplified mode of development,—as cenogenesis; it has arisen by lapse of the alternation of generations. Among the Craspedotæ, nearly all Trachylinæ (Trachomedusæ and Narcomedusæ) develop in this manner, but only a very few Leptolinæ (*e.g.*, the Cannotid *Dipleurosoma* = *Ametrangia*, System, p. 637). Among the Acraspedæ probably many Tesseronia (Stauromedusæ, Peromedusæ, and Cubomedusæ) are similarly developed directly from the ovum; their ontogeny is, however, unknown as yet. Among the Ephyronia (Discomedusæ) hypogenesis is as yet only known to be constant in *Pelagia* (whilst the closely allied *Chrysaora* undergoes metagenesis). *Aurelia* is usually developed with alternation of generations, but in isolated cases without it, directly from the ovum.

§ 18. Medusæ and Acalephæ. Since the alternation of generations with Polpys has been known in the Medusæ, great difficulties have arisen in the classification of the Acalephæ; and the natural class of Medusæ, which can be so easily distinguished from other classes of Cnidariæ, has therefore sometimes been even abandoned by many more recent authors. From the standpoint of the doctrine of evolution, however, these difficulties can be easily solved, and the Medusæ, at the same time reinstated as a class. According to the present extent of our knowledge, it appears most logical, and at the same time, natural to distinguish definitely the following five classes among the Acalephæ:—Class I. Polyps (*Polypi*) includes the common ancestral group of all Cnidariæ; it is divided first of all into two sections, Hydropolyps and Scyphopolyps. To the Hydropolyps (without tæniola) belong (*a*) the hypothetic ancestral form itself *Archydra* (also *Gastræa*, closely related to *Hydra*); (*b*) Hydropolyps without Medusa formation, and with simple genitalia (*Hydra*, *Clava*); (*c*) Hydropolyps with spore-sacs or medusoid genitalia (Tubulariæ, Campanulariæ); these spore-sacs or medusiform reproductive buds ("sporosacci") are Medusæ, which have undergone retrograde formation, without oral opening and without tentacles.

and organs of sense. To the Scyphopolyps belong: (*a*) the real ancestral form of the Acraspedæ (*Scyphostoma*); (*b*) the hypothetic ancestral forms of the corals (*Procorallium*); (*c*) Scyphopolyps, which are probably propagated as such without Medusa formation (*Spongicola, Stephanoscyphus*). Class II. Corals (*Coralla*, or *Anthozoa*) is phylogenetically derivable from the Scyphopolyps (*Procorallium*), probably a polyphyletic group (having arisen at different times from several different groups of the latter). Class III. Medusæ is most probably polyphyletic; the section of the Craspedotæ has likely arisen from several groups of Hydropolyps (Polyphyletic, § 11), but the section of the Acraspedæ from a single group of Scyphopolyps (Monophyletic, § 14). Class IV. Ctenophora is probably monophyletic, having proceeded from a group of Anthomedusæ (Cladonemidæ) (*Ctenaria*, System, p. 107). Class V. Siphonophora is probably polyphyletic, having proceeded from several forms of Anthomedusæ (Codonidæ, Sarsiadæ, System, pp. 14, 20, &c.). The Siphonophora are polymorphic Medusæ cormi or colonies, whose associated personæ have become differentiated by division of labour, and assumed very different forms.

§ 19. Ectocarp and endocarp Medusæ. As the Craspedotæ are more widely separated by the foregoing distinctions (above all by the absence of the gastral filaments and by the ectodermal genitalia), it is proposed to dissolve the class of Medusæ entirely, and to divide the whole tribe of the Acalephæ or Cnidariæ into two principal groups, of which one (Ectocarpæ) includes the groups just mentioned, the other (Endocarpæ) the Acraspedæ, the Scyphopolyps, and the Corals (with gastral filaments and with endodermal genitalia). This proposition seems entirely justified from a phylogenetic point of view, and we would accept it unconditionally, if we were in a position to carry out a phylogenetic system of the Cnidariæ completely and with certainty. Unfortunately, this is not the case at present. The most probable admission at present is, that the ancestral group of the Acalephæ (the primitive polyps, Archydræ, § 18) were early split up into the two diverging tribes of the ectocarp Hydropolyps (without tæniola) and the endocarp Scyphopolyps (with tæniola). The Craspedotæ (with the later side branches the Ctenophora and Siphonophora) issued from the former, the Acraspedæ and Anthozoa (Corals) from the latter. Only, as, moreover, a polyphyletic origin has now become more probable for the majority of the said classes of Cnidariæ, it seems more accurate for the sharp definition of these classes and their logical arrangement, to abandon at present carrying out a phylogenetic system and to define the said five classes to the extent known:—(1) Polypi, (2) Medusæ, (3) Siphonophora, (4) Ctenophora, (5) Coralla. If, on the other hand, we prefer to take their phylogenetic conditions as the fundamental plan of their systematic classification, it would be carried out according to the following table:—

§ 20. Survey of the two ancestral branches of the Acalephæ.

I. First Ancestral branch of the Acalephæ (without gastral tæniola, with ectodermal genitalia). Acalephæ ectocarpæ (Intæniolæ).	II. Second Ancestral branch of the Acalephæ (with gastral tæniola and endodermal genitalia). Acalephæ endocarpæ (Tæniolatæ).
1. Hydropolyps (common ancestral group of all Acalephæ, and first of all of the Intæniolæ).	5. Scyphopolyps (ancestral group of the tæniolatæ, derived from a branch of the Hydropolyps).
2. Craspedotæ (Hydromedusæ, which have originated from sessile Hydropolyps by adaptation to a free-swimming mode of life).	6. Acraspedæ (Scyphomedusæ, originated from sessile Scyphopolyps by adaptation to a swimming mode of life).
3. Ctenophoræ (an early side branch of the Craspedotæ—Anthomedusæ).	7. Coralla (Anthozoa, the principal group of the sessile Tæniolata, probably sprung from several branches of the Scyphopolyps).
4. Siphonophoræ (swimming colonies of Craspedotæ—Anthomedusæ), with polymorphism of the personæ.	

§ 21. Individuality of the Medusa. The tectological value, or the individual stage of form of the fully developed and mature Medusa is in every case that of an inarticulate transversely axonial (or radiate) persona ("persona inarticulata stauraxonia"). Each Medusa has, therefore, a vertical principal axis (with oral and aboral pole) and two or more horizontal transverse axes, perpendicular to it, with twice as many radii. The number of these radii (usually four) corresponds to the number of the radial sections or parameres which compose the body of the inarticulate persona and which only touch by their axial edges in the vertical principal axis of the body. Those Medusæ which form colonies or cormi, undergo at the same time considerable organological differentiations in consequence of extensive polymorphism of their personæ and become separated from the true Medusæ as a special class: the Siphonophora.

§ 22. Fundamental form of the Medusa. In all Acraspedæ and in the majority of Craspedotæ, the regular pyramid is the geometrical basis-form of the mature body, and the principal axis of the Medusa body (which is vertical in the normal position of the animal) is the axis of the pyramid; its upper (aboral) pole corresponding to the point, whilst its lower (oral) pole, with the oral opening, falls in the middle of the base of the pyramid. The angles of the regular pyramid (at least four) are transected by the primary transverse axes (with twice as many radii of the first order), whilst the middle lines of the lateral surfaces of the pyramid correspond to the indifferent radii of the second order.

§ 23. Primary cardinal number of the Medusa. In all Acraspedæ, and in the majority of Craspedotæ, the original cardinal number of the Cnidariæ (4) is invariably retained (apart from numerous individual exceptions). The geometrical fundamental form of the ordinary quadripartite Medusa is the quadrate pyramid or "quadrangular regular pyramid"; its base forms a square. Only two primary transverse axes exist (the two diagonals of the square), and these cross at right angles.

§ 24. Individual digressions from the primary or typical cardinal number. It is not unusual to find individual abnormalities of the fundamental number (more frequently in many groups or many species, more rarely in others), so that instead of four radii there are six or eight; less commonly other numbers (5, 7, 9, &c.); in single species (*e.g.*, *Aurelia aurita*) this inclination to individual variation of the fundamental number is very great; in some groups (*e.g.*, Cannotidæ, System, taf. ix.) it is constant in many species or genera, so that here of closely allied species or genera, some are quadripartite and others sexpartite. In some other groups (Æquoridæ, Cunanthidæ, Peganthidæ, Solmaridæ) the fundamental number is very large and indefinite; it may mount up to above a hundred (*e.g.*, *Æquorea forskalea*, *Æ. ciliata*, *Mesonema cærulescens*, *M. dubium*, &c.). The fundamental number is more inconstant the higher it rises, and therefore more unequal in the different individuals of a species.

§ 25. Secondary fundamental numbers of Medusæ. Next to the primary fundamental number 4, in the Medusæ only 6, 8, and 12 are prominently significant as secondary fundamental numbers. They become hereditary in many species and groups of species, and thereby acquire a systematic significance. On the other hand, the uneven numbers, 5 and 7, do not appear constantly in any single species of Medusa, but only as individual variations, and so do 9, 10, and 11. As soon as we get beyond the number 12 the fundamental number especially loses all morphological and systematic significance, as it then becomes inconstant and variable, and more so the higher it rises (Æquoridæ, Cunanthidæ, Peganthidæ, Solmaridæ). Moreover, as the fundamental number 8, which often recurs, and is constant in many groups, has arisen by duplication of 4, as the more unusual number 12 from duplication of 6, the most important secondary fundamental number next to the primary 4 really consists of 6; instead of the normal 2 transverse axes of the regular pyramid 3 are formed abnormally, and the hexagonal regular pyramid, therefore, appears instead of the quadrangular.

§ 26. Central and peripheric numbers. In all Medusæ it is only the central part of the body, pre-eminently the stomach, never the peripheric parts, which are the criterion for determining the true fundamental number or homotypical number. The peripheric parts, especially the umbrella margin with its appendages, show higher numbers than the central part in the majority of Medusæ. In most cases these higher numbers of the peripheric parts have arisen either by multiplication from the lower fundamental number of the central part or by regular multiplication according to definite conditions of progression. On the other hand, it rarely happens that the central part is four, and the peripheric part of the umbrella six (*e.g.*, *Polyclonia frondosa*). That the central umbrella usually retains the fundamental number by inheritance, whilst the peripheric part varies in several ways, is explained by the fact that the latter is subject in a higher degree to adaptation. (The fundamental number of all Rhizostomæ, for example, remains 4, with four oral pillars, four genitalia, &c., although they have all eight arms and from eight to twelve sense clubs, as well as a very variable number of marginal lobes.)

§ 27. Radii of the first to the fourth order. The radial structure of the Medusæ (like that of most radiata) is caused by the division of the growth of the central body (originally uniaxial in the gastrula) into different meridian planes. As the growth is more energetic in definite meridian planes, or radial planes (which touch in the common central principal axis), and leads to the development of new organs, the interlying radial planes continue indifferent or opposed, and usually in the middle between these energetic rays of growth. In this way an antithesis arises first of all between radii of Order I. and Order II., which we shall designate shortly "perradii" and "interradii." Special organs very often arise in the middle between the perradii and the interradii, and these then lie in the radii of Order III., the "adradii." Finally, we can distinguish in many cases radii of Order IV., or subradii, which lie in the middle between the eight adradii and the eight principal radii. In the "principal radii" we include the four perradii and the four interradii, whilst, in contrast to these, we term all other possible radii "succursal or secondary radii." Our distinction of these four orders of radii is of great importance, not only for the architecture of the Medusæ, but for the promorphology of most other "radiata"; it allows us to designate, in a single word, the most important conditions of position and relation of the organs with mathematical sharpness and precision. For example, *Ephyra*, the important ancestral form of all Discomedusæ (fig. A), has four perradial oral lobes and limbs of the oral cross (*as*), four interradial genitalia (*s*) and filaments or phacelli (*f*), eight adradial tentacles (*ta*), and sixteen subradial marginal lobes (*l*).

§ 28. Parameres and antimeres. As in all Acraspedæ, and in the majority of the Craspedotæ, 4 is the normal typical fundamental number of the body, the latter consequently consists of four parameres or "radiate parts," which touch in the common vertical principal axis of the body. These four parameres are originally congruent, so that a principal organ comes on each paramere,—an oral lobe, a quadrant of the stomach, a radial canal or a radial pouch, a septum or cathamma between the pouches, a primary tentacle, and so forth. Each paramere has a dipleuric fundamental form (or a strictly "bilaterally symmetrical" form), and therefore again consists of two equally symmetrical halves, the "counterparts" or antimeres. These two antimeres or counterparts comport themselves the same as the symmetrical halves of the body of all higher (dipleuric) animals. We can also distinguish three axes or "euthyna" in each paramere; the longitudinal axis of the paramere coincides with the central principal axis of the whole body; the sagittal axis (or "dorsoventral" axis) of the paramere is the perradius; its lateral axis (or transversal axis) lies tangentially, and touches the two adjacent parameres with its two poles ("right or left pole").

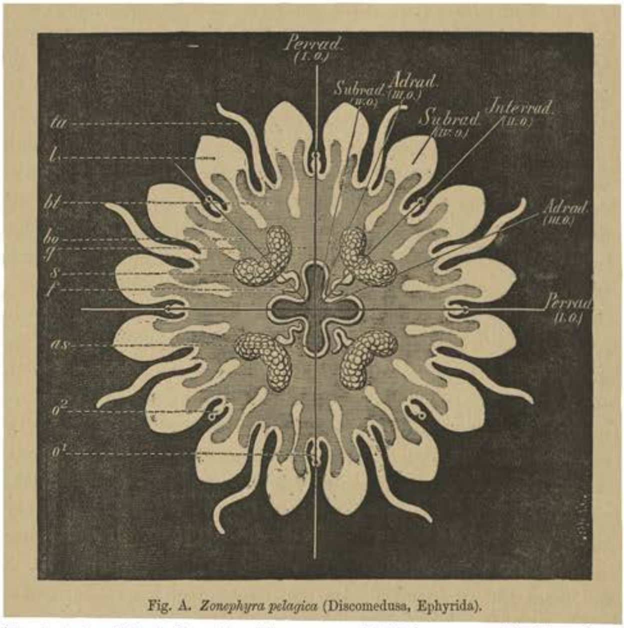


Fig. A. *Zonephyra pelagica* (Discomedusa, Ephyrida).

Subumbral view, giving the four orders of transverse axes (with twice as many radii). The oral cross (*as*) and the four perradial sense clubs (o^1) lie in the four perradii (Order I.). The gastral filaments (*f*), the genitalia (*s*), and the four interradial sense clubs (o^2) lie in the four interradii (Order II.). The eight tentacles (*ta*) and the tentacular coronal pouches (*bt*) lie in the eight adradii (Order III.). The sixteen marginal lobes (*l*) lie in the sixteen subradii (Order IV.). Sixteen bifurcate coronal pouches, eight tentacular (*bt*) and eight rhopalar (*bo*) radiate from the central stomach (*g*).

§ 29. Radial planes or meridian planes. In the Medusæ, as in all regular or symmetrically radially constructed animals, we can distinguish a number of radial or meridian planes, which have a high tectological and promorphological significance, and which are defined by the position of the vertical principal axis and of one of the horizontal transverse axes. As in all Acraspedæ, and in the majority of Craspedotæ, the body has the fundamental form of the quadrate pyramid, we can distinguish in them four principal meridian planes, which are defined by the position of the four perradii and the four interradii, and which stand in definite relation to the four parameres or pairs of antimeres (comp. woodcut, fig. A). The four perradii lie in the two primary meridian planes (or the "radial planes of Order I.") whilst the four interradii lie in the two secondary meridan planes (or the "radial planes of Order II."). Each of the two primary meridian planes is therefore the middle plane (or saggital plane) of each two opposite parameres and at the same time the boundary planes between the two symmetrical antimeres of each paramere. On the other hand, each of the two secondary meridian planes is the boundary plane (or septal plane) of the two adjacent parameres, and at the same time the boundary plane of their two contiguous antimeres. If the four corners of the quadrate pyramid correspond to the four perradii, its diagonal planes (in which each two opposite corners lie) are the primary meridian planes, whilst the secondary meridian planes are formed by the middle lines of each two opposite lateral surfaces of the pyramid.

§ 30. Regular and amphitect pyramids. Whilst all Acraspedæ and the majority of Craspedotæ retain the original primary fundamental form of the regular pyramid, in a large number of Craspedotæ (but in no Acraspedæ) it passes into the secondary fundamental form of the bisected or amphitect pyramid. In the former, all the four parameres of the body are completely congruent, whilst in the latter they are only congruent in pairs, as each two adjacent parameres are symmetrically similar. Whilst the base of the regularly quadrangular pyramid is a quadrate, that of the amphitect quadrangular pyramid represents a rhombus. As in the amphitect pyramid the two primary transverse axes are unequal in size, so, of the four parameres, each two adjacent are symmetrically similar, each two opposite are congruent. In these amphitect Craspedotæ it is usually the unequal development of the tentacles which first causes the alteration of the regular fundamental form. Of the four primary tentacles, the two opposite are much larger or the only ones developed, whilst the other two, alternating with them, are smaller or quite rudimentary (*e.g.*, *Thamnostylus*, Pl. I.; *Discodonium*, System, taf. i. fig. 6; *Ctenaria*, System, taf. vii. figs. 3, 5; *Dissonema*, System, taf. viii. fig. 3; *Dipetasus*, System, taf. xviii. fig. 2; *Æginella*, System, taf. xx. fig. 16). The promorphological conditions of the rhomboid pyramid are entirely the same in these amphitect four Craspedotæ as in the *Ctenophora*. In a few rare cases, the hexagonal amphitect pyramid also appears along with the quadrangular, the same promorphism which distinguishes most corals (*e.g.*, *Dipleurosoma*, System, taf. ix. fig. 9).

§ 31. Dipleuric or zeugite pyramids. The "pair pyramid," or zeugite pyramid, appears much more rarely than the amphitect form, along with the predominating regular pyramid as the geometrical fundamental form of the Medusæ. In such cases the whole Medusa persona has the same promorphological conditions as each one of the four parameres in the ordinary regular Medusa persona. This condition is only found strongly expressed in the Anthomedusa family of the Codonidæ, and characterises there the special subfamily of the Euphysidæ. In it, of the four perradial tentacles, three are rudimentary and transformed into marginal ocelli; the fourth tentacle only is developed, and therefore so much the more strongly. It is simple in *Euphysa* and *Steenstrupia* (System, taf. ii. figs. 8–14), but split into two to three filaments in *Amphicodon* (System, taf. i. figs. 7–9); whilst in the former the fundamental form of the umbrella is only altered a little, in the latter (as also in *Hybocodon*) it is considerably transformed symmetrically, and distinctly dipleuric or zeugite. The whole umbrella is here bilaterally compressed and divided by a sagittal plane (in which the curved gastral axis lies) into two symmetrical equal halves, a right and a left. The lateral transverse axis is equipolar and shorter than the polar sagittal transverse axis, which has often a tentacle at the one pole, and often has Medusæ buds at its base. The further the tentacle and its group of buds extends up the umbrella at this point, the more distinct the zeugite form becomes.

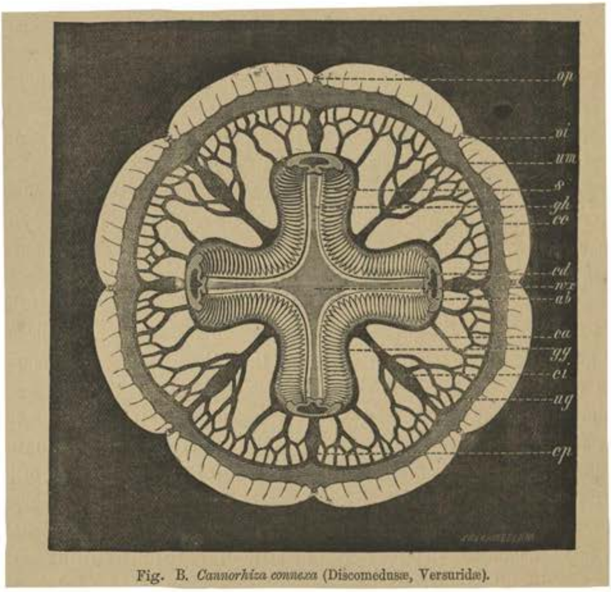


Fig. B. *Cannorhiza connexa* (Discomedusæ, Versuridæ).

Subumbral view of the umbrella. The arm disk with the eight oral arms is removed as the four perradial arm pillars (*ab*), which connect the umbrella disk and the arm disk, are cut through. (*oi*) Inter sense clubs. (*um*) Umbrella margin (turned over inwards). (*s*) Genitalia. (*wx*) Gelatinous cross of the gastrogenital membrane. (*gg*), (*gh*) Peripheric limbs of the gelatinous cross. (*ug*) Peripheric umbrella corona. (*cc*) Coronal canal. (*cd*) Pillar canals. (*ca*) Adradial canals. (*ci*) Interradial canals. (*cp*) Perradial canals.

This fundamental form has become predominant in the Medusoid personæ of the Siphonophora colonies. It appears also in the parasitic *Mnestra*, and is sometimes faintly indicated in some Cubomedusæ (Charybdea).

§ 32. Perradii, or transverse axes of Order I. In the ordinary regularly quadripartite Medusæ, the four perradii or "upper radii" lie in the two transverse axes of the quadrate pyramid perpendicular to each other, in the sagittal middle line of the four parameres, between these two antimeres. In most Craspedotæ the four oral angles, or oral lobes, the four radial canals, the four primary tentacles, and the four genitalia lie in the four perradii (or with dichotomised genitalia in the middle line of the perradii between the halves). In all Acraspedæ the four limbs of the oral cross and of the gastral cross (fig. B, *wx*) correspond to the four perradii, also the four oral lobes and the four oral pillars or primary oral arms (*ab*), and also the middle line of the four lobed primary radial pouches: in the Stauromedusæ and Peromedusæ in addition to these the four tentacles lie in the four perradii, and in the Cubomedusæ and Discomedusæ the four primary sense clubs (fig. B, *op*). In all Medusæ the perradii are originally the zones of the most active life, of the strongest growth, and most complicated differentiation, with preponderating tendency to centrifugal development of the organs.

§ 33. Interradii, or transverse axes of Order II. In the quadripartite Medusæ the four interradii lie exactly in the middle between the four perradii, and, therefore, intersect the latter at an angle of 45 degrees; they therefore lie at the same time in the boundary line, between the four parameres. In the quadrate Craspedotæ the four interradii form the geometrical middle line of the four injected oral archings (between every two perradial oral lobes), and also of the four broad cathammal plates (between every two radial canals); in the octonemal Craspedotæ (with eight tentacles) the four primary tentacles lie in the perradii, the four secondary in the interradii. In all Acraspedæ the four injected oral angles and oral columns lie in the four perradii, also the four fundamental tæniola or gastral ridges, and the four primary gastral filaments (or groups of filaments), and, finally, the four important cathamma (the four primary septal nodes or septal ridges). The interradii, moreover, form the middle line of the four genitalia in most Acraspedæ (fig. B, *s*), and also of the four pair of genitalia in such Acraspedæ in which the latter are divided into two halves. In all Medusæ the interradii are next to the perradii, the zones of the most intense growth and of the most important differentiation, but the tendency to development is predominantly centripetal with them, whilst with the perradii it is centrifugal.

§ 34. Adradii, or transverse axes of Order III. The eight adradii lie in the middle between the four perradii and the four interradii of the quadripartite Medusa; they halve the angles between the former and the latter, and intersect the two at an angle of 22½ degrees. They consequently lie at the same time in the median planes of the eight antimeres. If, on the one hand, we designate the four radii of Orders I. and II.

the principal radii, on account of their prominent morphological significance, radii of Orders III. and IV. belong, on the other hand, to the succursal or secondary radii, which can only claim a subordinate value as compared with the others. In most Craspedotæ the eight adradii are of no special value; they are often without organs, or only bear the eight tentacles of Order III. They are distinguished only in the vesiculated Leptomedusæ (Eucopidæ and Æquoridæ), as the eight typical "velar marginal vesicles" of this group lie in them (fig. C, *ov*, System, taf. xi., xiii.). The eight adradii are of much greater importance in the Acraspedæ. In these the eight hollow marginal "arms" of the Lucernaridæ and the homologous eight oral lobes of the Pericolpidæ lie in the eight adradii, also the eight marginal pouches of the Charybdeidæ and the eight tentacles of the Ephyra.

§ 35. Subradii, or transverse radii of Order IV. The sixteen subradii lie in all quadripartite Medusæ in the middle between the eight adradii on the one side and the eight principal radii (four perradii and four interradii) on the other; thirty-two angles of 11¼ degrees remain between the former and the latter. Contrasted with the positive significance of the principal radii, which in all Medusæ mark the active meridian planes of development, and the regular positions of the most important organs, the subradii have, at most, a completely negative value; they mark those meridian planes of the body which of all comport themselves the most passively and indifferently. In most Craspedotæ no special organs lie in them, excepting in some Narcomedusæ, as, for example, in *Æginura* (Pls. XIII., XIV.), where the sixteen internemal pouches (with the genitalia) and at the same time the sixteen auditory clubs of the umbrella margin lie subradially. In the majority of the Acraspedæ, the sixteen subradial planes are distinguished by the absence of all organs. In a few groups of this section only they mark the site of isolated marginal organs. For example, the sixteen marginal lobes of the Periphyllidæ, among the Peromedusæ (Pls. XVIII., XIX.), and of the Ephyridæ, among the Discomedusæ (woodcut, fig. A, *l*) lie subradially. The latter are so far of importance that the marginal lobes of all Discomedusæ have arisen from them : indeed, it is advantageous for the more accurate morphology of this division to distinguish two groups among the sixteen subradial "Ephyra lobes"; the eight Ephyra lobes, enclosed in pairs by the perradii, are corradial, whilst those enclosed in pairs by the interradii are exradial.

§ 36. Umbrella disk and umbrella corona ("discus umbrellæ" and "corona umbrellæ"). In all Medusæ the most important groups of organs of the body are divided in such a way that a certain regularity seems common to them all. We can recognise especially in distinct contrast two principal parts of the body between the central umbrella disk ("discus umbralis") and the peripheric umbrella corona ; the former contains the larger and most important part of the vegetative organs, the latter, on the contrary, the preponderating and most important part of the animal organs. The stomach and mouth, as well as the many important organs developed round the mouth (oral lobes, oral arms, &c.),

belong to the central umbrella discus. The peripheric umbrella corona, on the other hand, is characterised by the broad coronal muscle of the subumbrella, and, above all, by the umbrella margin, on which the central nerve system, and also the sense organs and tentacles lie, besides these the velum in the Craspedotæ and the lobe corona in the Acraspedæ.

§ 36. Topographical antitheses. It is indispensable for the clear, and detailed anatomical description of the Medusæ, to avoid the usual, but indefinite and dubious terms, "inner and outer, upper and lower" parts, &c., and instead of those to use definite topographical terms. For this purpose we represent the Medusa in its usual natural position with the vertical principal axis, the convex umbrella surface turning upwards, the concave umbrella surface turned downwards; the umbrella margin forms the boundary between them, in the more limited sense, the free velum margin in the Craspedotæ, the margin of lobes in the Acraspedæ. All the parts lying above this free margin (or the upper convex surface) we term dorsal or exumbral, all lying below it (on the lower, concave surface), ventral or subumbral; the marginal organs lie between the two on the umbrella margin. With regard to the two poles of the vertical principal axis, we term all the central parts which are turned towards its upper pole or apical pole "aboral," and those which are directed towards the lower pole or oral pole "oral." Finally, as regards the two poles of the radii or transverse axes, we name all parts of it which approach the central principal axis "proximal parts," whilst those which turn towards the peripheric margin are "distal" parts.

§ 38. Organic systems. All the different organs which are developed in the Medusæ may be divided into two large organic systems, the neurodermal and the gastrovascular system. The neurodermal system includes preferably the animal organs and apparatus; the umbrella with its exumbral umbrella-covering and subumbral muscular plate, the umbrella margin, with the most important organs of animal life, the central nervous system, the tentacles and the organs of sense. The gastrovascular system, on the other hand, consists principally of the vegetative organs of nutrition and reproduction, of the central principal intestine (with stomach and mouth), and of the peripheric coronal intestine (with pouches and canals), and also of the genitalia or reproductive glands, which are invariably developed in the subumbral wall of the gastrovascular system (sometimes from the ectoderm, sometimes from the endoderm). Taken altogether, the neurodermal system finds its most important site of formation in the peripheric umbrella corona, the gastrovascular system in the central umbrella disk; the former is preferably ectoblastic, the latter endoblastic.

II. GENERAL HISTOLOGY OF THE MEDUSÆ.

§ 39. Primitive germinal layer ("blastoderma"). In all Medusæ as in all other Metazoa, the aggregate cells of the developed body are descendants of the homogeneous, indifferent "segmentation cells," which are formed by repeated division of the fecundated egg cells, and which compose, first of all, the solid multicellular "mulberry germ" ("morula"). As fluid gathers inside this solid spheroidal accumulation of cells, and its homogeneous cells appear on the upper surface, this important hollow sphere, the "germinal vesicle" or "vesicular germ" ("blastosphera" or "blastula"), is originated, whose wall is composed of a single, simple layer of cells. This simple cellular membrane itself is the germinal membrane ("blastoderma") or the "primitive germinal layer." As the hollow sphere then forms a depression at one point of its upper surface, and this depression always deepens, the germinal membrane becomes invaginated, and thus differentiates into the two primary germinal layers composing the "gastrula." As the formation of the gastrula by invagination of the blastula in the Medusæ has been observed in very different groups, we may assume that it happens universally in this class, and supposed exceptions (*e.g.*, *Geryonia*) are founded on erroneous observations.

§ 40. Primary germinal layers ("ectoderma" and "endoderma"). The two primary germinal layers, which first of all arise from the primitive germinal layer, have the same fundamental morphological significance for the Medusæ as for all other Metazoa (gastræa theory). As these two layers regularly recur now in the gastrula of all Metazoa, we may assume that they have been transmitted by inheritance to all the groups from their common ancestral form, the *Gastræa*. According to the fundamental biogenetic law, they therefore appear to be constant in the gastrula of all Medusæ, which first develop by invagination of the blastula. The inner or vegetative germinal layer, the intestinal layer ("endoderma," or "endoblastus"), limits the cavity of the primitive intestine, as a simple nutritive cell layer, whilst the outer or animal germinal layer, the dermal layer ("ectoderma," or "ectoblastus"), covers and protects the former layer from the outside, as simple sensitive cell layer. In Medusæ generally, the cells of the two primary germinal layers (both the inner and the outer) are flagellate, high, cylindrical cells, each of which bears a single, long vibrating flagellum. Whilst the vibrating flagella are constant on the epithelial surface in the majority of the endoderm cells, they are lost in the majority of the ectoderm cells. The two great organic systems of the Medusæ stand in definite relation to the two primary germinal layers, just as they are distributed over the two principal sections of the body, the central umbrella disc, and the peripheric umbrella corona. The more numerous and most important parts of the neurodermal system arise from the ectoderm, those of the gastrovascular system, on the contrary, more usually from the endoderm. During the development of the Medusæ from the gastrula a histological differentiation of the two primary germinal layers appears everywhere, which leads, as in higher animals, to the formation of different tissues, and these tissues are regularly arranged in four strata, which in a certain sense may be considered as "secondary germinal layers."

§ 41. Secondary germinal layers. If we consider the histological differentiation and the structure of layers connected with it, of the organism of the Medusæ as a whole, and if we disregard the close connection of the different "principal layers" and "secondary layers," we can universally distinguish accurately four layers, which follow one another from the exterior, inwards :—(1) the dermal plate or dermal covering ("lamina chrotalis," "chrotoderma"), the layer of cells which covers the whole outer surface of the body in continuous connection and passes into the endoderm at the oral margin; (2) the muscular plate ("lamina muscularis," "myoderma"), the thinner or thicker muscular layer, which proceeds from the ectoderm and is chiefly spread over the concave lower side of the umbrella; (3) the connective plate ("lamina connectiva," "colloderma"), the gelatinous or cartilaginous mass secreted from the endoderm, which as a thicker "gelatinous umbrella" forms, according to volume and weight, the principal mass of the body in all Medusæ, but which is also found as the thinner "supporting lamella" in the subumbrella and the tentacles; (4) the intestinal plate or intestinal epithelium ("lamina gastralis," "gastroderma"), which lines the whole inner upper surface of the umbrella in continuous connection, and passes into the ectoderm at the oral margin. Although the muscular plates are for the most part produced from the ectoderm, and the connective plates, on the other hand, from the endoderm, we must distinctly remember that in isolated cases it is reversed, and muscles are formed from the inner germinal layer and supporting plates from the outer.

§ 42. Two opposite views may be held in histologically judging the organism of the Medusæ. On the one hand, the Medusæ may be considered as diblastic animals, as, in the majority of them, all the tissues which appear between the two primary germinal layers remain in close connection with them, are referable with certainty to one of the two, and only acquire a slight amount of independence. But, on the other hand, we may consider part of the Medusæ (and in a certain sense all of them) as mesodermal (triblastic or tetroblastic animals), as in certain parts of the body (and in some Medusæ to a great extent) independent tissues are really secreted between the outer and the inner germinal layer, and so form a middle germinal layer ("mesoderma"). The following tissues may be pre-eminently regarded as independent mesodermal tissues :—(1) the gelatinous tissue of the umbrella as soon as it contains independent cells; (2) the chordal tissue in the axis of the solid tentacles; (3) the muscular tissue of isolated, especially strongly developed muscles; (4) the nervous tissue in a part of the nerve centres and the organs of sense. In a secondary degree, but less accurately, the following may claim to be termed mesodermal tissues :—(1) the reproductive tissue; (2) part of the urticating tissue (the subepithelial urticating organs); (3) all subepithelial muscles; (4) all subepithelial nervous plexus. The latter, however, want the complete histological independence and the entire separation from the mother-epithelia, already attained by the former. On the whole we find autonomic mesodermal formations chiefly in the higher and larger Acraspedæ, in which both the volume of the body and the organological separation have reached a very high grade, whilst they remain at a much lower stage in the smaller Craspedotæ, which are much lower in this respect. If then isolated organs are found on definite parts of the body, in which the different forms of tissue of the animal's body have attained the same high and independent formation, as in the higher animals, there is nothing to prevent us terming these secreted layers of tissue true "secondary germinal layers" (even though these are only developed locally). The two middle plates, the ectodermal muscular plate, and the endodermal connective plate, may be classed together as mesoderm according to the following diagram.

Diblastic Theory.		Tetroblastic Theory.	Triblastic Theory.
Primitive germinal layer, "Blastoderma."	I. Primary dermal layer, "Ectoderma," *s.a.* ("Ectoblastus").	1. Secondary dermal plate ("Chrotoderma").	External germinal layer, "Ectoderma," *s.st.*
		2. Muscular plate ("Myoderma").	Middle germinal layer, "Mesoderma."
	II. Primary intestinal layer, "Endoderma," *s.a.* ("Endoblastus").	3. Connective plate ("Colloderma").	
		4. Secondary intestinal plate ("Gastroderma").	Inner germinal layer, "Endoderma," *s.st.*

§ 43. Differentiation and teleosis of the tissues. The great and general interest presented by the histological structure of the body of the Medusæ does not only lie in the fact that we can distinguish the origin of the four secondary germinal layers from the two primary, and especially the derivation of the mesoderm from the two primary germinal layers, more certainly and clearly in them than in the higher Metozoa, but also that in them we can more clearly recognise the mechanical causes of these fundamental processes. These mechanical causes, on the one hand, are the physiological division of labour of the cells and the differentiation of the tissues proceeding from it, and, on the other hand, the physiological perfection of the cells and the progressive development or teleosis of the tissues resulting from it. If these processes of development continue to be carried on now by inheritance in the ontogenesis of the Medusæ, the result has been originally brought about in their phylogenesis according to the laws of the theory of selection.

§ 44. Primary and secondary tissues. The importance of the Medusæ for general histology lies chiefly in this, that within this class a long series of histological differentiations and teleoses are developed from the simplest beginnings, step by step before our eyes. Whilst at definite parts of the body (that is in many higher and larger Medusæ) all the four principal forms of the animal tissues are already secreted as independent layers, they appear in other parts of the body (that is, in many smaller and lower Medusæ) still in a dependent form, as mere appendages of a single fundamental tissue, the epithelium. The most different degrees of formation of tissue are represented beside each other in genetic connection, within this long series of perfection and differentiation, so that the most important forms of the higher tissues are to be found here "in statu nascenti." In this respect the Medusæ furnish an excellent argument in favour of the tenet, recently brought forward in the gastræa theory, that there is only one primary tissue, the epithelial tissue, and that all other forms of tissue have arisen secondarily from it. The simplest and phylogenetically oldest form of this primary tissue is the blastoderm of the "blastula," this simple single-layered epithelium, which alone forms the wall of this hollow sphere in the germ of all Medusæ, in the same way as it does in the germ of all other groups of Metazoa. When the two-layered gastrula is formed by invagination of the blastula, the blastoderm (or the simple "primitive germinal layer") of the former is divided into the "primary germinal layers" of the latter, which are likewise simple epithelia. All other formations of tissue (connective, muscular, and nervous tissues) have arisen, both ontogenetically and phylogenetically, from these two epithelia.

§ 45. Epithelial tissue ("tela epithelialis"). The protective tissue or epithelium, which in the gastrula of the Medusæ, as of all Metazoa, is formed first of all by the simple tissue of the multicellular germ, in the mature and developed Medusa, covers firstly, as outer covering ("ectoderm"), the whole upper surface of the body; and secondly, as inner covering ("endoderm"), the whole inner surface of the gastrovascular system. These coverings are everywhere separated from one another by secondary formations of tissues, secreted between them, and only pass uninterruptedly into one another at the oral margin. This oral margin (*am*) is identical with the "primitive oral margin" of the gastrula or the "invagination opening" of the invaginated blastula. The inner covering ("epithelium endodermale") shows far simpler and more uniform conditions of formation in both coverings. However, most of the differentiations recur in it, which appear more expressed and varied in the outer covering ("epithelium ectodermale"), corresponding to its manifold adaptations and relations to the outer world.

§ 46. Outer covering ("epithelium ectodermale" or "chrotale"). The outer covering or chrotal epithelium (which may also be termed "ectoderma" in the more restricted sense) in all Medusæ covers the entire outer upper surface of the umbrella as a connected dermal covering, and only passes into the endodermal epithelium at the umbrella margin (in some Medusæ at the excretory papillæ of the umbrella). Corresponding to the form of the concave-convex umbrella, we distinguish two different principal parts of its ectodermal epithelium, which pass into one another at the umbrella margin, the dorsal and the ventral chrotal epithelium, or the "exumbrella" and "subumbrella." Both are distinguished in the same way as the dorsal and ventral endoderm. The exumbrella or the dorsal ectoderm (also termed "chrotal epithelium of the notumbrella," or shortly "upper ectoderm") covers the whole convex surface of the gelatinous umbrella in the form of a delicate, flat epithelium of very uniform and indifferent character. The cells of this epithelium are usually extremely thin, but very extensible polygonal plates, which lie immediately on the gelatinous body, and are covered on their upper surface by a very delicate cuticule; this often looks dotted or granulated, as at definite distances on it there are thickenings in the form of nodules or small papillæ. Vibrating flagellate cells are wanting for the most part on the dorsal exumbrella, but they are often found on definite limited spaces, especially on and near the umbrella margin; the flagella are then usually very delicate and fine. Pigment cells and urticating cells are more frequently found in the exumbrella, especially in the vicinity of the umbrella margin and in the projecting radial ribs, ridges, nodes, and papillæ with which the convex outer surface of the umbrella is covered in many Medusæ. The subumbrella or ventral ectoderm (also termed the "chrotal epithelium of the coelumbrella," or shortly the "lower ectoderm") covers the entire concave surface of the gelatinous umbrella from the oral margin to the umbrella margin (in the Craspedotæ to the free margin of the velum, in the Acraspedæ to the free margin of the lobe-corona or of the velarium). It shows a much more complicated and varied nature than the dorsal ectoderm. Its cells are usually higher, more cubical, partly covered by a cuticle, partly not covered. Part of the cells bear vibrating flagella at definite points, and feeling bristles at others. In the same way, urticating cells, glandular cells, and also often pigment cells are richly developed in many regions. The differentiation of the ectodermal epithelium is most varied and important at the actual margin of the umbrella, and its appendages, such as the tentacles, marginal lobes, and organs which are developed there. Thus we can often separate a special "subepithelial layer of cells" from the true epithelium (which only covers the free surface). As numbers of thread-cells are often developed, a special "urticating tissue" ("tela urticaria") often arises, which, especially in the Trachomedusæ and Narcomedusæ, forms a thick "urticating ring" and the "umbrella-clasps" ("peronia") running out from it. The firm and thickly accumulated nematocysts there lose their original function of protective weapons, and attain the significance of a supporting dermal skeleton (urticating skeleton, § 71). Another portion of the ventral ectoderm, and, in fact, that portion which covers the subumbral wall of the gastrovascular system in the Craspedotæ, furnishes a subepithelial layer from which the reproductive cells, both male and female, originate in this section of the Medusæ.

§ 47. The inner covering ("epithelium, endodermale," or "gastrale"). The inner covering or gastral epithelium (also termed "endoderma" in the more limited sense), in all

Medusæ, lines the entire extent of the hollow space of the gastrovascular system, consists everywhere of a simple layer of flagellate cells, and passes into the ectodermal epithelium only at the oral margin. Corresponding to the shape of the umbrella enclosing the gastral space, we can also distinguish in this endoderm two different principal parts contiguous at the umbrella margin, the dorsal epithelium, and the ventral epithelium of the gastrovascular system. Both show striking and constant differences. The dorsal endoderm (or the "gastral epithelium of the notumbrella," often also simply termed the "umbral or upper endoderm") lines the concave inner surface of the thick dorsal umbrella, and covers its gelatinous body in the form of a thin, uniform, flat epithelium of very indifferent character (Pl. IV. figs. 6–8, *du*; Pl. IX. figs. 5–7, *du*; Pl. XXV. figs. 8–10, *du*). The ventral endoderm (or the "gastral epithelium of the coelumbrella," often also simply termed the "subumbral or lower endoderm") covers the convex inner surface of the thin ventral umbrella, and is stretched across its subumbral supporting plate in the form of a high differentiated cylindrical epithelium (Pl. V. figs. 6–8, *dw*; Pl. IX. figs. 5–7, *dw*; Pl. XXV. figs. 8–10, *dw*). Its cells are much larger than those of the dorsal endoderm, are often extremely high, and enclose plasma products of various kinds, fat, granules of pigment, crystals, amyloid granules, and other products of a vital change of tissue, but also numerous vacuoles which not unfrequently coalesce. In many places, that is at the œsophagus, one part of these ventral endoderm cells is transformed into glandular cells, and another into urticating cells; epithelial muscular cells and even perhaps sense cells appear to originate from it here in some places. Finally, it is also these ventral endodermal cells which form the reproductive cells in all Acraspedæ; both ova cells and sperm cells proceed from a subepithelial layer of the ventral endoderm. This ventral gastral epithelium is plainly of the highest significance for the aggregate changes of tissue of the Medusæ, whilst the opposite indifferent dorsal endoderm is only of slight importance; these cells are, moreover, "flagellate cells," as in both cases they invariably bear a vibrating flagellum. This flagellum is only missing on the cathammata, those important points at which the dorsal and the ventral endoderm are fused together. Whilst the whole gastral cavity originally shows in the polyps a perfectly simple cup-shaped cavity without radial sections, in the Medusæ it is divided in the course of development into peripheric radial sections, by the fusion of the two walls of the gastral cavity (the dorsal outer wall and ventral inner wall) in definite radia. In this way there originate the important fused plates or cathammata which represent the septa of the radial chambers. Each "cathamma" or "septum," therefore, actually consists of two layers of the gastral endodermal epithelium which have been laid firmly one upon the other, and fused together at those points. These two closely connected layers can sometimes be plainly distinguished (as in many Acraspedæ, Pl. XXV. figs. 8–10), and are sometimes fused into a single simple layer (as in most Craspedotæ). In both cases we designate this simple or double layer of cells as the fused plate, or cathamma plate ("lamina cathammalis," otherwise also "endodermal lamella," and "vascular plate"; comp. under "Cathamma," §§ 100, 101).

§ 48. Connective tissue ("tela connectiva"). The connective tissue (padding tissue or supporting tissue), whose various modifications are included in the idea of the "connectivum"), appears among the Medusæ in two different principal forms, as supporting plates without cells ("fulcra"), and as padding tissue containing cells ("maltha"). The two forms correspond to different phylogenetic stages of development, as the cell-less supporting plate or fulcral plate only represents a simple secretion of the epithelium, which has no independent value as mesoderm; we can only consider as mesoderm the cellular filling tissue or malthar plate, by which cells are produced from the endoderm and are divided by an intersubstance ("secreted tissue"). Both forms are produced in general from the endoderm; though both forms are also produced in a few isolated places from the ectoderm.

§ 49. Supporting tissue or cell-less connective tissue ("fulcrum," "tela fulcralis," "lamina fulcralis"). Under this name we include all forms of the connective tissue which do not contain cells, and are therefore merely structureless or fibrous secretions of the epithelia. They appear in two principal forms, which, however, appear inseparably connected by transitions, as thin elastic membranes and as thick gelatinous masses. The thin elastic supporting membranes are found everywhere in the bodies of the Medusæ as the foundation of the epithelium, and especially of the endoderm, although strongly developed supporting plates often appear also among the ectoderm at definite spots, *e.g.*, in the velum of the Craspedotæ (Pl. VI. figs. 13, 14, *zv*; Pl. IX. fig. 7, *zr*); and in the tentacles of many Acraspedæ. The structureless fulcral lamellæ are generally very thin but very firm; in transverse section, under strong magnifying power, they appear sometimes simple, sometimes doubly contoured, usually strongly refractive. On account of their great elasticity, they are often of physiological importance as antagonists of the muscles (*e.g.*, as extensors of the tentacles and oral styles). This is also the case with the thick cell-less gelatinous tissue, which is only distinguished from the thin elastic supporting membranes by its more extensive, often very apparent volume of development. This forms the principal mass of the gelatinous umbrella (and consequently of the whole body) in the majority of the Craspedotæ, as in this section the collosoma is usually without cells, and appears as a structureless secretion of the endoderm; it also forms the principal body mass in part of the Acraspedæ (*e.g.*, Cubomedusæ, Pelagidæ, Cyaneidæ). The cell-less "fulcral gelatinous tissue," is, moreover, usually (or always?) traversed by numerous elastic fibres, in the same way as the cellular "malthar gelatinous tissue."

§ 50. Padding tissue or cellular connective tissue ("maltha," "rete malthare," "lamina maltharis"). Under this name (for want of a better) we include all the different forms of cellular connective tissue, in contradistinction to the cell-less supporting plate, the fulcral tissue. All the different forms of the "cellular connective tissue" in the higher animals (bones, cartilage, vascular tissue, mucous tissue, &c.), belong to this filling tissue or malthar tissue; in the Medusæ it actually appears only in two essentially different forms, as gelatinous tissue and as chordal tissue. The cellular gelatinous tissue ("tela gelatinosa") is the more important as to extent and distribution. It forms the principal mass of the gelatinous umbrella (and therefore of the whole body) in the majority of the Acraspedæ (namely, in most of the larger forms), whilst it is replaced by the cell-less "fulcral gelatinous tissue" in the majority of the Craspedotæ. The cells of the "malthar gelatinous tissue" are usually scattered sparsely at great distances in the structureless intercellular substance, but sometimes also in greater numbers (namely, near the cathamma) (Pl. XXV. fig. 10). They usually proceed from the endoderm, from whose epithelial layer they have passed into the underlying fulcral layer ("endodermal secreted layer," principally in the umbrella and subumbrella). Similar "ectodermal secreted tissue, "whose cells proceed from the ectoderm (as in the velum of the Pectyllidæ, Pl. V. fig. 7, *x*; Pl. VI. fig. 13, *x*), are more rarely found. The consistency of the gelatinous tissue varies greatly, as on the one hand it may become extremely soft mucous tissue (*e.g.*, the umbrella of the Aurelia), and on the other, a very firm, hard fibrous cartilage (*e.g.*, the cathamma of the Peromedusæ (Pl. XXV. figs. 8, 10). Near these firm fused ridges, the cathammal plates in particular, the gelatinous tissue of many Acraspedæ acquires a nature which so resembles the true "fibrous cartilage" of the vertebrates both in histological structure and physical quality as to be easily confounded with it. In this case the extraordinary firmness of the cellular tissue is chiefly formed by thickening and by the fibrous differentiation of the intercellular substance, whilst the softer or firmer nature of the gelatinous tissue seems usually dependent upon the qualitative and quantitative development of the elastic fibres in it. The latter comport themselves in the cellular gelatinous tissue in the same way as in the cell-less tissue and usually pass from the ectodermal on to the endodermal surface of the gelatinous umbrella (Pl. IX. figs. 5–7, *uf*). They are either simple or branched, usually cylindrical, more rarely flattened like a ribbon (Pl. VI. fig. 19). They are sometimes combined into an elastic network or grouped in branches (Pl. V. fig. 8, *us*). The second principal form of the padding tissue is the characteristic chordal tissue ("tela chordalis"), which greatly resembles the tissue of the "chorda dorsalis" of vertebrates. It is found everywhere in the solid tentacles of the Medusæ, and forms their characteristic firm axis. This is usually cylindrical, and consists of a single row of large, discoid, flat, circular endodermal cells, lying one above the other like the coins in a rouleau of sovereigns (Pl. I. fig. 57; Pl. VI. fig. 17; Pl. XII. fig. 11; Pl. XIII. figs. 5, 6). Each cell is surrounded by a very thick, firm, elastic membrane, and encloses contents as clear as water. The protoplasma of the cell is usually limited to a thin wall-layer, lining the inside of the capsule-shaped membrane, and to a central axial cord, which connects the middle of the proximal and distal wall-layer; the two are sometimes connected by a network of fine threads of protoplasm, traversing the cavity of the cell (Pl. I. fig. 7). The nucleus sometimes lies in the middle of the axial cord, sometimes at the one end. These chordal cells belong to the largest cells of the body of the Medusa; they are often visible to the naked eye, being about 1 mm. broad (p. 38). They sometimes also form a special chordal ring at the umbrella margin (Pl. VIII. fig. 8, *y*). In the short thick tentacles, the chordal cells of the tentacle axis seem sometimes disposed in layers (Pl. IV. figs. 5–8, *yt*; Pl. VI. figs. 12–15, *dt*). The base of the axis is usually still continuously connected with the endoderm of the coronal canal; more rarely it becomes completely separated from it, and, therefore, mesodermal (Pls. IV., VI., XII., &c.). In the gelatinous tissue the small cells retreat entirely against the powerful intercellular substance; the reverse is the case in the chordal tissue.

§ 51. Muscular tissue (" tela muscularis "). The muscles of all Medusæ consist of fine muscular fibrillæ laid parallel, which are connected somewhere with a small lump of protoplasm containing nuclei, and must, therefore, be regarded as filamental processes of muscular cells. The fibrillæ are usually very long and thin, sometimes cylindrical, sometimes flattened like a ribbon; in most longitudinal or radial muscles the fibrillæ are smooth, not striated, but they are more or less plainly striated in the transversal or circular muscles. Both the smooth and the striated muscular cells originate for the most part from the ectoderm. In isolated spots, however, both kinds are also formed from the endoderm (as for example at the œsophagus and the oral arms). With regard to the relation of the muscular cells to their original place of formation, the epithelium, we distinguish two principal forms of the muscular tissue; epithelial muscular cells and mesodermal muscular cells; the latter still lie in the true epithelial layer of the upper surface or immediately below it, whilst the latter have become completely separated from it and form an independent, though thin, mesodermal layer.

§ 52. Epithelial muscular cells (" myoblasti epitheliales," " tela muscularis epithelialis "). The majority of the Medusæ muscles, that is in the section of the Craspedotæ, are composed of smooth or striated fibrillæ, whose muscular cells do not form an independent mesodermal layer, but either belong to the endodermal epithelium itself or to a subepithelial layer lying immediately below it. The fibrillæ of these " epithelial muscular cells " or " neuro-muscular cells " therefore lie immediately under the epithelium from which they proceed, and on the supporting plates on which they are borne. They are usually placed in a parallel layer beside each other, or arranged in several layers one above the other in such a way that they form flat leaves or lamellæ. By further development of the muscles, these " muscular leaves " become arranged in folds, whilst the supporting lamellæ bearing them forms corresponding composite folds by local thickening, as, *e.g.*, in the larger hollow tentacles of the Geryonidæ, and of the Cyaneidæ, &c.; in the velum of some Craspedotæ (Pl. VI. figs. 13, 14). In the smaller and lower Medusæ, the broad coronal muscle forms a simple, smooth, band-shaped plate on the umbrella surface, whilst in many larger and higher Medusæ the supporting plate of the subumbrella is raised in concentric circular folds, which are covered by corresponding folds of the muscular plate (*e.g.*, *Lucernaria*, Pl. XVII. fig. 20; *Periphylla*, Pl. XXII. fig. 22).

§ 53. Mesodermal muscular cells ("myoblasti mesodermales" "tela muscularis mesodermalis"). When the folded epithelial muscular leaves increase in extent and become further developed, their growth is not limited to the formation of folds, but the epithelial or subepithelial muscular cells emerge completely from their point of origin, the epithelium, and form independent "mesodermal muscular cells." As they separate in great quantities from the epithelium and become united to special plates or bundles, they pass inwards, in the connective tissue and form perfectly independent mesodermal muscles. Such mesodermal muscles are more commonly found in the system of the longitudinal muscles than of the circular muscles, more rarely and chiefly in the larger species among the Craspedotæ, but more frequently among the Acraspedæ. Thus, for example, in the large Peromedusæ, the powerful deltoid muscles of the subumbrella, the longitudinal muscles, and root muscles of the tentacles, &c. (Pls. XX.–XXIV. *md*, *mk*, &c.), belong to this category. Here the muscles are frequently detached so completely from the epithelium that later on they are separated from it by a special supporting lamella or even a thick gelatinous plate. The external coronal muscles of *Atolla*, which increases to 4 mm. broad by 2 mm. thick, and are composed of many layers of coronal muscular fibres, lying the one above the other, form one of the strongest mesodermal masses of flesh (Pl. XXIX. figs. 4, 7, 8, *mc''*). Among the Craspedotæ, *Pectis* furnishes an example of strong mesodermal muscles in the velum and subumbrella (Pl. V. fig. 7; Pl. VI. figs. 12–14, *m*).

§ 54. Nervous tissue ("tela nervea.") The two essential component parts of nervous tissue, which are distinguished as nerve cells and nerve fibrillæ in the higher animals, are also already differentiated in the Medusæ; the two compose the central as well as the peripheric part of the nervous system, even though their situation and connection in the central nerve ring of the umbrella margin is different from that in the nervous plexus of the subumbrella, and so forth. Both the nerve cells and the nerve fibrillæ, which proceed from and connect them, are, for the most part, products of the ectoderm and have hitherto been considered to be exclusively such. Nerve cells and nerve fibres are found in isolated places in some (and perhaps all) Medusæ, which originate from the endoderm, as on the very movable and sensitive oral parts (oral filaments, oral lobes, oral arms, oral pouches). It is probable that on the gastral inner surface of these oral organs the endoderm forms both muscular cells and nerve cells, among the latter we may perhaps look for specific sense cells (gustatory cells? olfactory cells?). These difficult conditions require much closer investigation. In any case, both this localised and slightly extended ectodermal nervous tissue, and the more important and widely diffused ectodermal nervous tissue are most closely connected with the epithelium from which they are originated. The whole muscular system in the Medusæ preserves more or less its original epithelial character. We can therefore distinguish here, as in the muscular tissue, purely epithelial and subepithelial cells; the former may usually be termed sense cells, the latter ganglion cells. Both are connected by very fine fibrillæ, thread-shaped processes, which are repeatedly branched and combined into network and nerve plexus.

§ 55. Sense cells or epithelial nerve cells ("cellulæ sensillares," "sensoblasti"). Under this title we include all these nerve cells (in the widest sense) which lie in the epithelium itself, and which have fine thread-shaped processes or fibrillæ at their bases, by which they are connected with other cells of the nervous system. These sense cells are sometimes scattered singly in the epithelium between its indifferent covering cells (*e.g.*, on many places in the tentacles and œsophagus), sometimes, as a connected covering, they form a true sensitive epithelium (*e.g.*, on the dorsal nerve ring of the Craspedotæ, and on the margin of the velarium of the Acraspedæ). We can distinguish two principal forms of sense cells, indifferent or neutral, and differentiated or specific sense cells. We call those epithelial sense cells "indifferent," to which we cannot assign a specific function of sense, and which therefore represent the oldest and simplest form of the nervous elements. Provisionally we may consider as such in the Medusæ, all those flagellate cells and bristle cells of the ectoderm which are connected at their base, directly or indirectly, by processes and nerve fibrillæ with other nerve cells, and in which we recognise no specific sensitive function (Pl. XIV. fig. 9). All these neutral sense cells have a fine hair-shaped process on their free upper surface, which is movable in the sensitive flagellate cells (*e.g.*, on the sense epithelium of the nerve ring), but stiff in the bristle cells. We include in the latter the true tactile cells (without nematocysts, with a tactile bristle, "palpocilium") and also the thread cells (with nematocysts and with an urticating bristle, "cnidocilium"). How far the flagellate cells and thread cells of the ectoderm belong to the category of indifferent sense cells depends upon their passing at their base into communicating processes or nerve fibrillæ (comp. below § 79, organs of touch). We may consider as differentiated or specific sense cells such epithelial nerve cells to which from their situation, structure, or connection, we can assign some specific sensitive function. To this category belong—(1) the olfactory cells (or gustatory cells?) on the clavellæ of the Craspedotæ (Pl. II. fig. 8, *q*) and on the protective scales of the rhopalia in the Acraspedæ; (2) the vision cells of the eyes, which are sometimes differentiated into pigment cells and rod cells; (3) the auditory cells of the auditory organs (Pl. VI. fig. 16). The last bear a free, usually long and thin auditory hair, and therefore do not differ in form from the ordinary tactile cells (with a tactile bristle) from which they are also derived phylogenetically; they become "auditory cells" as they are in functional connection with "otolite cells" which contain an otolite, and belong to the ectoderm in one order only (the Leptomedusæ) and in all other orders to the endoderm. In some cases (*e.g.*, in most Leptomedusæ and in the Geryonidæ) the auditory cells become completely separated from the free epithelium to which they originally belonged; they are then transformed into mesodermal interior epithelium, as the open olfactory depressions become detached from the dermal covering and from closed auditory vesicles.

§ 56. Ganglion cells or mesodermal nerve cells ("cellulæ gangliosæ," "neuroblasti"). The ganglion cells bear the same relation to the sense cells as the mesodermal muscular cells do to the epithelial. The ganglion cells are, in fact, subepithelial nerve cells secreted from the epithelium, from which they have originated both ontogenetically and phylogenetically; they are still connected directly or indirectly with this their point of origin by thread-shaped processes, the nerve-fibrillæ (Pl. XIV. fig. 10). All ganglion cells of the Medusæ appear to have two or more processes, and are, therefore, either bipolar (fusiform) or multipolar (stellate) cells. Both forms appear both in the central and in the peripheric nervous system; the bipolar cells, however, preponderating in the central nerve ring, the multipolar ganglion cells in the peripheric nervous plexus; the former therefore lie principally in the umbrella margin, the latter in the subumbrella. The central ganglion cells, moreover, both in the nerve ring and in the organs of sense, show definite conditions of relation and position to the neighbouring organs, especially to the sense cells of the epithelium. In the Craspedotæ, the dorsal (or exumbral) nerve ring covered by the sense epithelium is formed for the most part of parallel lying, circular fibrillæ, and is much poorer in ganglion cells than the ventral (or subumbral) nerve ring which has no sense epithelium and is more motor. In the Acraspedæ the ganglion cells seem rather to be accumulated at the bases of the sense clubs, and to form four or eight ganglia which are sometimes connected by a centralised ring of bundles of fibrillæ (Cubomedusæ), sometimes by a more decentralised plexus of fibrillæ. The peripheric ganglion cells are scattered, sometimes sparsely, sometimes pretty numerously in the nervous plexus, which extends chiefly in the subumbrella in the form of delicate,reticulate plexus of fibrillæ; this subumbral plexus lies between the muscular plate of the subumbrella and the endodermal epithelium, from which the latter has arisen. Both this peripheric nerve plexus and the central nerve ring may already be regarded as mesodermal nerves, as they possess independent cells, secreted from the epithelium.

III. NEURODERMAL SYSTEM OF THE MEDUSÆ.

§ 57. Composition of the neurodermal system. Of the large organic systems composing the body of the Medusæ, the neurodermal system includes the aggregrate animal organs, the apparatus of sensation and motion. This is therefore opposed physiologically to the gastrovascular system, which forms the complex of the vegetative organs. This antithesis is also shown histologically in reference to the two primary germinal layers, as the greater and most important parts of the neurodermal system originate from the ectoderm (or "animal germinal layer"), whilst those of the gastrovascular system originate chiefly from the endoderm (or "vegetative germinal layer"). The apparatus of motion, formed by the umbrella and the wide-spread muscular plates, situated on the concave surface of the umbrella cavity, is by far the more considerable although the less differentiated of the two apparatuses which compose the neurodermal system. The apparatus of sensation is less extensive, but more strongly differentiated; it is situated chiefly on the umbrella margin, and includes the nervous system along with the tentacles and differentiated organs of sense.

§ 58. Umbrella (*u*). The typical and most characteristic principal organ of the Medusæ, which distinguishes them from the ancestrally-allied polyps, is their peculiar swimming organ, the umbrella. From its volume and weight this always forms the principal mass of the body, and consists of a voluminous gelatinous body ("collosoma") which contains a large amount of water, and is sometimes almost as soft as mucus, sometimes almost as hard as cartilage. It is more or less "umbrella-shaped," convex above, arched concavely below. The general form of the umbrella, however, varies greatly. Sometimes its vertical diameter (or "the central principal axis") is greater than the greatest horizontal diameter (or the transverse axis), and the umbrella is thin, conical, bell-shaped, pyramidal, or obelisk-shaped (as in most Anthomedusæ, Stauromedusæ, Peromedusæ, and Cubomedusæ, Pls. XV.–XXVI.). Sometimes, on the contrary, the horizontal diameter is greater than the vertical, and the umbrella, therefore, more discoid, hourglass-shaped, or semi-spheroidal (as in most Leptomedusæ, Trachomedusæ, Narcomedusæ and Discomedusæ (Pls. I.–XIV., XXVII.–XXXII.). The gelatinous body is usually thickest in the middle of the umbrella, and decreases sometimes regularly, sometimes more suddenly towards the umbrella margin. If we take the umbrella and the parts of the gastrovascular system enclosed in it as a whole, we may term the outer convex surface the "outer umbrella" or "exumbrella" (*e*), and the inner concave surface the "inner umbrella" or "subumbrella" (*w*). More accurately speaking, however, the umbrella consists of two distinct gelatinous plates which may be distinguished as the dorsal umbrella ("umbrella dorsalis," or "notumbrella") and the ventral umbrella ("umbrella ventralis," or "coelumbrella"); the former corresponds to the "calyx" or dorsal wall of the polyps, the latter to their "peristomium" or ventral wall. Both walls pass immediately one into the other only at the umbrella margin, and are elsewhere separated by the hollow space of the gastrovascular system, whose bounding surfaces are only fused together at definite points. The exumbrella is the free convex surface of the thick dorsal wall; the subumbrella is the free concave surface of the thin ventral wall.

§ 59. Umbrella dorsalis ("notumbrella," upper or dorsal umbrella). In the more limited sense this part is usually simply termed the "umbrella," as it forms the principal mass of the umbrella, and as its voluminous gelatinous disk is much thicker than the thin gelatinous plate of the ventral umbrella. Its upper convex surface, covered with dorsal ectoderm, is the "exumbrella" (*e*). Its lower concave surface forms the outer or abaxial wall (umbral wall) of the gastrovascular system, and is covered by its flat "dorsal endoderm." The two epithelial layers of the dorsal umbrella, the outer ectodermal layer and the inner endodermal, are separated by the powerful mass of the gelatinous body ("collosoma"). They never run into one another, as they pass immediately at the umbrella margin into the two corresponding epithelial plates of the ventral umbrella. The endodermal epithelium of the dorsal umbrella consists of flagellate cells of an indifferent nature, whilst its ectodermal epithelium often forms thread cells, more rarely also epithelial muscular cells ("exumbral muscles").

§ 60. Exumbrella. The convex outer surface of the dorsal umbrella, which we call shortly the "exumbrella" in many Medusæ, is perfectly smooth, arched equally without any special characteristic, and covered uniformly by the simple ectodermal epithelium. In many other Medusæ, on the contrary, it is distinguished by repeated projections in the form of nodes, ribs, ridges, spicules, &c. These projections are often distinguished by accumulations of thread cells, often also of pigment cells, and therefore serve as weapons of defence of the umbrella. Projecting radial urticating ribs are found among the Craspedotæ that is in many Anthomedusæ, *e.g.*, four perradial in several Codonidæ and Tiaridæ, eight adradial in *Ectopleura* and *Ctenaria* (System, taf. vii. fig. 7), sixteen in *Pectyllis* (Pls. III., IV.), *Pectanthis* (Pls. VII., VIII.), and *Tesserantha* (Pl. XV.). In *Corynetes* the whole exumbrella is overspun with a network of ridges, having projecting urticating papillæ at their points of junction; more commonly the urticating papillæ are scattered equally over it (*e.g.*, *Thamnostylus*, Pl. I.). Among the Acraspedæ, such projecting urticating ribs are of less morphological importance than the deep furrows of the exumbrella, by which the latter is divided into a number of gelatinous plates. Very often there is a deep and distinct circular furrow or coronal furrow, which separates the central umbrella disk from the peripheric umbrella corona. Whilst the former is usually smooth, the latter, on the contrary, is often divided by radial furrows into projecting "gelatinous sockels or pedalia," which serve to bear the tentacles and rhopalia, as *e.g.*, in *Periphylla* (Pls. XVIII., XIX.), *Nauphanta* (Pls. XXVII., XXVIII.), and *Atolla* (Pl. XXIX.). The exumbrella of *Cephea* (System, taf. xxxii.) bears large, conical urticating papillæ.

§ 61. Umbrella ventralis ("coelumbrella," lower umbrella or ventral umbrella).

This part of the umbrella is usually simply termed umbrella in the wider sense, though this name really belongs only to its lower concave surface, which is covered by ectoderm. Its upper, convex surface forms the inner or axial wall (subumbral wall) of the gastrovascular system, and is covered by its high "ventral endoderm." The two epithelial layers of the ventral umbrella, the ectoderm of the concave surface (subumbrella), and the endoderm of the convex surface, only pass into one another at the umbrella margin, and are likewise separated by a thin but firm supporting plate (*zw*). This fulcral lamella of the subumbrella is equivalent to the thick gelatinous body of the dorsal umbrella, though much thinner, and passes immediately into the umbrella margin at the edge of the latter. The endodermal epithelium of the ventral umbrella consists of high flagellate cells, which also often form glandular cells, whilst its ectodermal epithelium (the "subumbrella" in the more restricted sense) originates the most important part of the muscular system of the Medusæ ("subumbral muscles").

§ 62. Subumbrella. The convex inner surface of the ventral umbrella, which we designate shortly as the "subumbrella" (in the more restricted and special sense), is of special importance as bearing the muscular system, which affects the swimming motions of the Medusæ. It is, moreover, distinguished by varied differentiations of the ectodermal epithelium, lining the umbrella cavity enclosed by it. Thus, for example, glandular cells, pigment cells, and thread cells are often found disposed in a certain order on its ectoderm, and in all Craspedotæ it also forms the point of origin of the reproductive glands. Whilst in most of the smaller Medusæ (for example, the Craspedotæ) the subumbrella appears smooth and regularly vaulted, in most of the larger Medusæ (chiefly Acraspedæ) it is folded repeatedly and distinguished by special projections. Among the more important of these are the gelatinous ridges which serve for the wider superficial extension of the subumbral muscular system. They usually run in concentric rings (*e.g.*, on the coronal muscle of the Peromedusæ (Pls. XIX., XXII.), more rarely in radial bunches (*e.g.*, *Drymonema* (Pls. XXX., XXXI.). The mesenteries of many Anthomedusæ, and Trachomedusæ, Stauromedusæ, and Cubomedusæ may be mentioned as special processes of the subumbrella, which project into the umbrella cavity in the form of vertical radial septa; we shall speak of them further on in the "umbrella cavity" along with the various secondary cavities and niches, which penetrate from the umbrella cavity into the subumbrella (§§ 91, 94).

§ 63. Central and peripheric umbrella ("discus centralis" and "corona peripherica"). In all Medusæ a certain morphological and physiological contrast can be recognised more or less distinctly between the central and the peripheric part of the umbrella; the most important part of the vegetative gastrovascular system lies in the former, the most important part of the animal neurodermal system in the latter. We term the central principal section of the umbrella, enclosing the stomach and mouth along with the oral organs, the umbrella disk ("discus umbralis"), the peripheric principal section containing the umbrella margin along with the most important part of the muscular and nervous systems (sense organs and tentacles) the umbrella corona ("corona umbralis"). These two principal sections of the umbrella correspond at the same time to the two principal sections of the gastrovascular system, as the central principal intestine is situated in the umbrella disk, but the peripheric coronal intestine in the umbrella corona. The boundary between the disk and the corona is often sharply defined externally, as an exumbral coronal furrow ("fossa coronaris") is inserted more or less deeply between the two, as in many Narcomedusæ (Pls. IX.–XII.), Peromedusæ (Pl. XVIII.), Cubomedusæ (Pl. XXVI.), and in a few Discomedusæ, very distinctly in many Cannostomæ (Pls. XXVII.–XXIX.). The central umbrella disk is more discoid or lens shaped ("umbrella lens," "lens umbralis") in the depressed Medusæ, but more conical or bell shaped ("umbrella cone" "conus umbralis") in the higher vaulted Medusæ. In the Craspedotæ the peripheric umbrella corona ends in the typical velum of this section, but in the Acraspedæ in the characteristic lobe corona or velarium.

§ 64. Umbrella peduncle and umbrella cupola ("pedunculus umbralis" and "cupola umbrellæ"). In many Medusæ, though only in the minority, the "apex of the umbrella" (the uppermost, aboral and proximal part of the "notumbrella") is not arched and rounded as usual, but prolonged into a projecting apical process or a conical, peduncle-like process. In one order only, the Stauromedusæ, it is developed into a true umbrella peduncle ("pedunculus umbrellæ"), whose aboral end, the "foot plate," serves for adhesion to the bottom of the sea or to foreign bodies (Pls. XVI., XVII.; System, taf. xxi., xxii.). But in many other Medusæ of different orders (namely, of Anthomedusæ and Peromedusæ) in place of an apical peduncle we find a peculiar umbrella cupola or conical apical process ("cupola umbrellæ") at the top of the umbrella. This is the equivalent of the adhering peduncle, and contains, like it, a cæcal axial "apical canal" or "peduncle canal" (*Tesserantha*, Pl. XV. figs. 1–3, *p*). A special morphological interest attaches itself to these parts in that they are heirlooms from the polyp ancestors of the Medusæ, and are homologous with the peduncle and peduncle canal of the polyps, by means of which the latter are fastened to the bottom of the sea.

§ 65. Gastral peduncle and gastral cone ("pedunculus gastralis" and "conus gastralis"). An oral process is often found, though only in the Craspedotæ, on the concave inner surface of the central umbrella disk, in the same way as the umbrella peduncle or the umbrella cupola is developed from it as an aboral process. This oral process first appears as a flat, insignificant, conical elevation in the centre of the endodermal hollow surface of the "notumbrella," and projects, more or less, into the central gastral cavity (System, taf. xi. xiv. xv.). By further growth from this gastral cone, a long cylindrical gelatinous peduncle is developed, which projects far into the umbrella cavity or even beyond the umbrella opening, and which takes the surrounding parts of the "coelumbrella" along with it. The gastral sac lies no longer, as usual, in the bottom of the umbrella cavity, but at the distal end of a free solid gastral peduncle. The radial canals originating in the bottom of the stomach run in the ectodermal outer surface of the cylindrical gastral peduncle (which is often also quadrangularly prismatic, pyramidal, or conical) to the bottom of the umbrella cavity, turn over on to the subumbrella, and run in it to the umbrella margin. The longitudinal muscles which move the gastral peduncle, alternate with its ascending radial canals. The solid gastral peduncle frequently resembles the hollow, and likewise proboscis-shaped œsophagus of the Craspedotæ and has often been confounded with it. The gastral peduncle is never found among the Acraspedæ, but is very frequent in all four orders of the Craspedotæ. It is most strongly developed in a part of the Leptomedusæ (Saphenidæ) and Trachomedusæ (Geryonidæ). (Comp. System, taf. iv. xii. xiii. xviii. xx.). In a portion of the Geryonidæ it runs out still further below, past the central part of the umbrella peduncle and forms a pointed cone, projecting freely like a tongue into the hollow space of the stomach, which is fastened below to the gastral peduncle (System, taf. xviii. fig. 5). This tongue-like cone ("conus lingualis," "glossoconus") is perhaps an organ of taste.

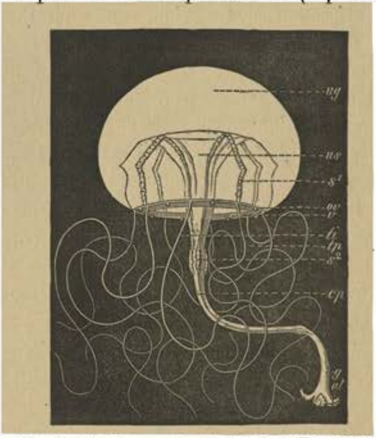


Fig. C. *Octorchis germanica* (Leptomedusæ, Eucopidæ).

Profile view. (*ug*) Gelatinous umbrella. (*us*) Solid gelatinous peduncle of the stomach. (*v*) Velum. (*ov*) Velar marginal vesicles. (*tp*) Perradial tentacles. (*ti*) Interradial tentacles. (s^1) Distal testis (on the subumbrella). (s^2) Proximal testis (on the œsophagus). (*cp*) Perradial canals. (*g*) Stomach. (*al*) Oral lobes.

§ 66. Umbrella margin ("margo umbrellæ," *um*). The umbrella margin forms the lower or distal boundary line of the umbrella, at which its two walls, the dorsal and the ventral wall, pass into one another; at the same time the exumbral epithelium of the convex dorsal umbrella (*qe*) proceeds directly at this boundary line into the subumbral epithelium of the concave ventral umbrella (*qw*). The umbrella margin is the most important part of the neurodermal system in all Medusæ, both morphologically and physiologically, as in it the most important animal organs—organs of sense, nerves and muscles—attain their highest development. The central part of the nervous system and the tentacles especially are always originally situated in the umbrella margin. The umbrella margin is also of great importance for classification, as it is chiefly on it that the variations of formation appear which lead to the distinction of genera and species. In fact the distinction and nomenclature of the two principal divisions of the Class Medusæ, of the two sections Craspedotæ and Acraspedæ, are taken from the umbrella margin, which presents important and striking diversities in the two sections. The "velum" is characteristic of the former, the "lobe corona" of the latter.

§ 67. Umbrella margin of the Craspedotæ: velum ("diaphragma"). In all Craspedotæ or Hydromedusæ a direct process of the free umbrella margin projects inwards from it; the marginal veil or "velum" (also termed "swimming membrane" or "diaphragma") is wanting in all Acraspedæ or Scyphomedusæ. The velum forms a thin, membranous, broader or narrower ring, which in a state of rest sometimes hangs loose vertically from the umbrella margin, and is sometimes stiffly stretched horizontally and projecting inwards, narrowing the entrance of the umbrella cavity more or less. In the Pectyllidæ (Pls. III.–VIII.) the velum is so broad that it can probably close the entrance into the umbrella cavity when fully extended. In most Narcomedusæ it is very broad, whilst it is very narrow in many Leptomedusæ; in *Obelia* it is rudimentary. We can always distinguish in the velum a free distal margin and a basal proximal margin, inserted at the umbrella margin; likewise a ventral inner surface and a dorsal outer surface. The ventral or subumbral surface of the velum is covered with the ectoderm of the "subumbrella," the dorsal or exumbral surface with the ectoderm of the "exumbrella"; below the latter there lies a thin supporting plate, below the former a muscular plate, composed of circular fibres, which is a direct process of the coronal muscular layer of the subumbrella (comp. Pls. IV.–VI., IX.–XIV.).

§ 68. Collar lobes of the Narcomedusæ. Whilst in most Craspedotæ the velum is stretched at equal breadth all round the umbrella margin, in the order of the Narcomedusæ it undergoes peculiar transformations as the umbrella corona (or "collar"), and is separated by deeper or shallower incisions of the margin into a number of separate "collar lobes" (at least four, *Cunarcha*, Pl. IX.; usually eight or more, Pls. X.–XIV.). These often closely resemble the true marginal lobes of the Acraspedæ, and are usually confounded with them; they differ entirely, however, in origin, structure, and signification. The collar lobes of the Narcomedusæ originate in the tentacles, abandoning their original insertion on the umbrella margin and migrating more or less upwards into the umbrella. They then take with them a process from the urticating ring of the umbrella margin, in the form of a radial (centripetal) urticating streak, which as the "umbrella clasp" ("peronium") keeps up the connection between the ectodermal epithelium of the tentacle and the umbrella margin. The peronia transect the gelatinous body as far as the subumbrella, and at the same time form deeper or shallower indentations at the dorsal bases, which in the Peganthidæ (Pls. X.–XII.) become deep incisions of the umbrella margin. The velum which fills them naturally appears much broader here than at the margin of the underlying collar lobes; it connects the latter in the same way as the velarium of the Cubomedusæ does the true marginal lobes of this order (§ 70).

§ 69. Umbrella margin of the Acraspedæ: lobe corona ("corona lobaris"). Whilst the velum appears in all Craspedotæ or Hydromedusæ as a characteristic process of the umbrella margin, it is generally wanting in all Acraspedæ or Scyphomedusæ. A velum-like membrane ("velarium"), which in some families of the latter (Charybdeidæ, Aurelidæ) forms a narrower or broader membranous selvage at the umbrella margin (Pl. XXVI. *vu*), is perfectly different from the true velum both as to origin and structure. On the other hand, all Acraspedæ have a lobe corona ("corona lobarum"). This is usually wanting in the Craspedotæ, as the gelatinous "collar lobes" which are developed in some groups of the latter (Narcomedusæ, Pls. IX.–XIV.), but are connected by the velum, cannot be compared to the true marginal lobes of the Acraspedæ. The latter may rather be essentially considered as shallow, leaf-shaped "steering tentacles." They have one or two longitudinal muscles on their concave subumbral surface, by whose contraction they

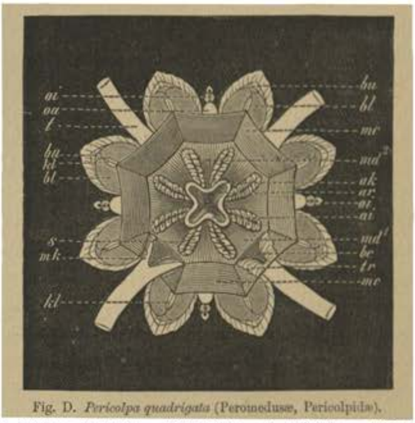


Fig. D. *Pericolpa quadrigata* (Peromedusæ, Pericolpidæ).

Subumbral aspect. (*oi*) Sense clubs (interradial). (*oa*) Ampulla at their bases. (*t*) Tentacles (perradial). (*bl*) Marginal lobes (adradial). (*bu*) Horseshoe-shaped canals of the lobes. (*kl*) Peronia between the two limbs of the canals. (*s*) Genitalia. (*mk*) Root muscles of the tentacles. (*md*¹) Perradial deltoid muscles. (*md*²) Interradial deltoid muscles. (*ak*) Oral ribs. (*ar*) Oral grooves on their inner surface. (*ai*) Oral tæniola. (*ti*) Tentacle roots. (*br*) Coronal pouches. (*mr*) Coronal muscles.

can operate like a helm in the motion of swimming. From the ontogeny of the Acraspedæ (*Aurelia*) it is probable that their marginal lobes have really originated phylogenetically from tentacles. A three-cleft *Scyphostoma* tentacle can have given rise in the *Ephyra* formation to a rhopalium and the two "ocular lobes" enclosing it. The number of the lobes varies greatly. In the Acraspedæ there are at least eight adradial marginal lobes (fig. D, Pls. XVI.–XVII.). In place of these, however, we usually find sixteen subradial (Pls. XVIII.–XXVIII.), and their secondary number is often considerably increased (Pls. XXX.–XXXII.).

§ 70. Velarium of the Cubomedusæ. Whilst in most Acraspedæ the marginal lobes project freely at the umbrella margin, alternating with the tentacles and rhopalia, the Craspedotæ are distinguished by the marginal lobes being fused together or connected by a thin intermembrane, like a swimming membrane (Pl. XXXVI.; System, taf. xxv.–xxvi.). In this way a muscular, broad, thin marginal membrane is formed, which strongly resembles the velum of the Craspedotæ, and has hitherto been generally considered homologous with it: it differs completely from the latter, however, both in its origin and its finer construction, and is therefore more appropriately termed velarium. The true velum of the Craspedotæ, and the velarium confounded with it of the Cubomedusæ have arisen quite independently of one another and in a different manner; the two bear a completely different morphological relation to the umbrella margin and to its nerve ring. The velarium of the Cubomedusæ is usually traversed by canals (distal processes of the coronal pouches), (Pl. XXVI. fig. 8), whilst this is never the case in the velum of the Craspedotæ. Moreover, the velarium in most Cubomedusæ is suspended by four perradial "frenula" (or gelatinous ridges of the subumbrella. Comp. above and Pl. XXVI. figs. 2, 8, *vf*). The velarium differs in the two families of the Cubomedusæ, inasmuch as it is composed of eight adradial marginal lobes in the Charybdeidæ, but of sixteen subradial marginal lobes in the Chirodropidæ. The marginal lobes are fused to a velarium in the same way, but not so apparently in many Discomedusæ, such as the Rhizostomæ. It is very broad, for example, in *Drymonema* (Pls. XXX., XXXI.). A narrow circular border of the umbrella margin, which in some Discomedusæ is developed below the corner of tentacles (Aurelidæ, System, taf. xxxiii. fig. 8, *va*) differs both from the velarium and from the true velum of the Craspedotæ.

§ 71. Urticating organs ("nematillæ," "nematophora," "organa urticantia," *n*). In all Medusæ, as in Acalephæ or Cnidaria in general, special organs are formed from the epithelium at definite parts of the body, which are essentially composed of nematocysts ("cnidoblasti"), and are therefore termed urticating organs or "nematillæ." In the Medusæ these are for the most part products of the ectoderm, whilst the endoderm only forms nematillæ in a few places, as for example, on the gastral filaments and in the oral cavity. The urticating organs serve chiefly as weapons of attack and defence (as, for example, the tentacles), but at the same time also as firm supports of the soft body (as, for example, at the umbrella margin). The urticating weapons (" arma urticaria ") appear under very varied forms as roundish urticating knobs (in the whole ectodermal surface), closed urticating rings (in the outer wall of the tentacles), narrow urticating streaks or flat urticating pads (at the umbrella margin), conical urticating papillæ (in the exumbrella and subumbrella), composite urticating clubs and urticating batteries (at the end of the tentacles), and so forth. All these urticating weapons consist of epithelial accumulations of numerous urticating cells, which usually lie compacted in the upper surface of the ectoderm, and which throw the urticating threads and fluid from their thread cells, when their freely projecting urticating bristle ("cnidocilium") is touched. They are usually developed in a subepithelial layer, the " interstitial tissue." As soon as the thread cells and their filaments are fully developed in the cnidoblast they become erect, and pass from the subepithelial into the superficial epithelial layer. When this is very thin and flat (*e.g.* in the exumbrella) the thread cells originate in the epithelial cells of the upper surface itself. In many places, principally on the umbrella margin, the thread cells lose their original significance as weapons, accumulate thickly compacted in firm masses, and so assume the function of a supporting skeleton. Such subepithelial urticating skeletons (" sceleta urticaria ") attain a high development in the Trachylinæ (Trachomedusæ and Narcomedusæ). They sometimes form a firm urticating ring on the umbrella margin (on the distal margin of the coronal canal (Pls. IX.–XIV. *nc*), sometimes radial urticating streaks, which run centripetally from the urticating ring and rise upwards in the exumbrella. These centripetal urticating streaks serve as firm, elastic support, sometimes for the freely projecting auditory clubs (auditory clasps " otoporpæ," Pls. IX.–XIV. *oo*), sometimes for the dorsally inserted tentacles, whose bases they connect with the umbrella margin (umbrella clasps, " peronia," Pls. IX.–XIV. *en;* comp. § 68). As the cnidoblasts in these supporting shields are accumulated in a number of layers, the one above the other, and lie deep under the epithelial upper surface, the enclosed filaments, which are no longer able to escape, lose their function as armature, whilst the hard nematocysts which assume the supportive function of the firm and elastic cartilaginous tissue become proportionately more strongly developed (Pl. XIV. fig. 12, *en*).

§ 72. Nervous system. In all Medusæ the nervous system stands at a very low stage of development, as it retains the most immediate connection with its place of development, the ectodermal epithelium, and as neither its central nor its peripheric parts have become completely and independently separated. We can usually distinguish in all Medusæ a central and a peripheric section of the nervous system. The circular central part lies either on the umbrella margin or above it on the subumbrella; whilst the peripheric part extends chiefly on the subumbrella in the form of a diffuse nervous plexus. Both in the central and peripheric part we find smaller and larger ganglion cells, mixed with finer and coarser fibrillæ (Pl. XIV. figs. 9, 10). These cells are most closely connected on the one side with the "sense epithelium" of the ectoderm lying below it (namely, at the umbrella margin and the organs of sense), and on the other with the underlying muscular plate (namely, at the subumbrella and the œsophagus). Independent "ganglia" separated into units, or centralised nerve knots, and visible "nerve fibres" consisting of bundles of separate nerve fibrillæ are only developed in a few surfaces (*e.g.*, *Charybdea*, Pl. XXVI.). We ought, however, to observe that the most recent numerous and important researches on these difficult conditions are still too insufficient to allow us to form exhaustive and certain conclusions on the subject. On the one hand we know nothing of the nervous system of several principal groups of the Medusæ (for example, of the two orders of Stauromedusæ and Peromedusæ); on the other hand, in the remaining orders, the nervous system has not been examined on important parts of the body, on which from their greater mobility and great sensibility it is probably very highly developed, pre-eminently on the œsophagus and the oral organs. As far as we can judge at present the nervous system of the two sections presents essential differences, as it appears more strongly centralised in the Craspedotæ, more diffuse in the Acraspedæ.

§ 73. Nervous system of the Craspedotæ. In all Craspedotæ, of which the nervous system has been minutely examined up to this time (and among these we find some belonging to all the four orders), its important centre represents a double marginal nerve ring, lying on the proper umbrella margin immediately outside the insertion of the velum. It is covered externally by a ciliated sense epithelium, consisting of small flagellate cells, and is divided by the supporting plate of the velum insertion into two separate rings, an exumbral and a subumbral ring. The dorsal or exumbral nerve ring (Pl. IX. fig. 7, *rc′*; Pl. XII. fig. 12, *rc′*) is the so-called upper ring (the outer or lower in the normal position of the velum), and seems to be pre-eminently the central organ of sense; it contains smaller and scantier ganglion cells, also finer fibrillæ, and specially provides for the different organs of sense of the umbrella margin (namely, the auditory clubs and the tentacles). The ventral or subumbral nerve ring (Pl. IX. fig. 7, *rc″*; Pl. XII. fig. 12, *rc*) is the so-called "lower" ring (the inner or upper ring in the normal position of the velum), and appears to be pre-eminently the motor central organ; it contains larger and more numerous ganglion cells, as well as several fibrillæ, and provides specially for the muscular system of the velum and the subumbrella. The two nerve rings are immediately connected by numerous fine filaments, which pierce the separating fulcral lamella of the insertion of the velum, and give out numerous filaments which extend like a plexus and are in connection with many peripheric ganglion cells. In many Craspedotæ the nerve ring shows slight swellings, which are perhaps radial ganglia at the points of insertion of the tentacles (especially at the four perradial and four interradial).

§ 74. Nervous system of the Acraspedæ. The structure of the nervous system in the first two orders of the four orders of this section, the Stauromedusæ and Pero-Medusæ, is next to unknown; the two other orders seem to comport themselves in somewhat different ways. The Cubomedusæ (Charybdeidæ and Chirodropidæ, Pl. XXVI. figs. 25, 26) are distinguished by a strong simple subumbral nerve ring which runs above the umbrella margin at a considerable distance from it. It lies embedded in a groove of the subumbrella, whose muscular plate is interrupted by it, and consists of a clear axial cord, two turbid cords of fibrillæ (an upper and an under) lying on the former and a peculiar overlying nerve epithelium. The nerve ring is swollen at eight places into eight ganglia. The four perradial ganglia are larger and lie higher at the bases of the four highly developed sense clubs; they send out sensible nerves to the sense clubs and motor nerves to the muscular plate of the subumbrella. The four interradial ganglia lie deeper at the basis of the four strong tentacle pedalia, and send out both sensible and motor nerves to the umbrella margin and the tentacles. Wide-spread plexus of fibrillæ, in which numerous multipolar and fusiform ganglion cells are situated, lie in the subumbrella and the velarium, and are connected with the nerve ring and its eight ganglia. The nervous system of the allied Peromedusæ, where we may expect to find the nerve ring in the depth of the exumbral coronal furrow or at the coronal muscle, is probably of the same nature as that of the Cubomedusæ. On the other hand, the nervous system of the Discomedusæ, which has been often examined, varies in its nature in so far that the nerve ring retreats whilst the principal sense clubs (four perradial and four interradial) appear in the foreground as eight separate marginal nerve centres. Each of these eight sense clubs or marginal bodies in the Discomedusæ contains in itself the organs of sense described below, and its base encloses an independent nerve centre, which here, and as in the Cubomedusæ, may be termed the principal ganglion. This consists of a thick pad of nerve fibrillæ and ganglion cells, which are in immediate connection both with the underlying tactile cells of the ectodermal sense epithelium and with the remaining organs of sense of the rhopalium. Other filaments connect it with the nervous plexus of the subumbrella, which extends between the ectodermal epithelium and the muscular plate of the latter, and contains large motor ganglion cells. The bundles of fibrillæ which form immediate connection between the eight principal ganglia of the rhopalia and correspond to the strong nerve ring of the Cubomedusæ may be looked for in the Discomedusæ in the bottom of the umbrella cavity.

§ 75. Organs of sense (" sensillæ "). All Medusæ possess organs of sense on the umbrella margin. The umbrella margin itself is covered for the most part with sense epithelium; it is the mother-ground and place of origin of different sensillæ. These appear in the simplest (and almost universally spread) form as tentacles, which are plainly homologous to the margin tentacles of the polyps from which they have originated phylogenetically. The sensillæ are represented only by tentacles in few groups of Medusæ. In most groups besides tentacles we find differentiated organs of sense on the umbrella margin, which have proceeded partly from undeveloped tentacles, and have partly arisen independently of these. As far as we are able at present to decipher the difficult physiological significance of the different organs of sense, we can distinguish four categories of organs of sense in the Medusæ, according to the specific energy of each, viz. :—1. Organs of touch, mechanical tools for the perception of touch and pressure; such, above all, are the tentacles with manifold ectodermal cell formations, which appear specially adapted for the perception of mechanical stimulation—viz., tactile bristles, tactile combs, &c. Besides the tentacles, special tactile organs are often found at many places (namely, at the umbrella margin and the margin of the mouth). 2. Organs of smell or organs of taste, chemical sense tools for the perception of the mixture or rarefaction of the sea-water; these are probably always present (perhaps hidden under the tentacles already mentioned); the clavellæ of the Craspedotæ, and the funnel-shaped depressions on the rhopalar protective scale of the Acraspedæ, may be perhaps regarded as special olfactory organs. 3. Organs of vision. Ocelli or pigment eyes, with or without a lens principally and widely extended on the umbrella margin and the basis of the tentacles; sometimes adapted for thermatic perceptions, sometimes for optical (eyes for warmth, eyes for light). 4. Organs for hearing, appearing in several different forms on the umbrella margin, among which we can distinguish two originally different types, velar auditory vesicles with ectodermal otolites and tentacular auditory clubs with endodermal otolites. All the four kinds of organs of sense may be found united in one and the same "sense tentacle," as is the case with the "sense clubs" or "rhopalia" of many Acraspedæ. As the umbrella margin is the site of the greater number of different sensillæ, in the Medusæ they were usually given the indifferent name of marginal bodies ("corpuscula marginalia"), which only indicated their situation.

§ 76. Tentacles (*t*). The tentacles or feeling filaments are by far the most important organs of the umbrella margin of the Medusæ, as they not only represent the oldest and simplest organs of sense of this class of urticating animals, but at the same time of their limbs. The tentacles are originally placed on the umbrella margin ("marginal filaments"), and are used as feelers as well as sense organs, also as weapons for attack and defence, as sucking-cups for adhesion by suction (Pectyllidæ, Pls. III.–VIII.), as steering organs for swimming, or as manducatory organs for leading the nourishment seized on to the mouth ("filaments of prehension"). Only the small group of the Amaltheidæ among the Craspedotæ, and the large group of the Rhizostomæ among the Acraspedæ are distinguished by complete absence of tentacles; in them the tentacles have undergone retrograde formation and become lost. As the tentacle corona of the Medusæ corresponds to that of their ancestors, the polyps, the conditions of formation and structure are in general the same in both classes. The tentacles in most Medusæ are placed in a circle on the umbrella margin, just as they are placed on the corresponding peristomial margin or calyx margin in most polyps. In the Medusæ they usually form a single row, and are regularly distributed in it according to number and arrangement (§ 77). More rarely two or more rows of tentacles are placed on the umbrella margin, the one above the other, and are then usually compacted in larger numbers (*Pectyllis*, Pls. III., IV.; *Pectis*, Pls. V., VI.). The tentacles sometimes appeared grouped together in bushes or bundles on the umbrella margin, as in the Lizusidæ and Hippocrenidæ (System, taf. v., vi.), and in *Pectanthis* (Pls. VII., VIII.) among the Craspedotæ; and in the Lucernaridæ (Pls. XVI., XVII.) and the Chirodropidæ (System, taf. xxvi.) among the Acraspedæ. Deviation from the original marginal insertion sometimes takes place, as the tentacles either migrate outwardly on the dorsal surface of the umbrella or inwardly on the ventral surface. Exumbral insertion, on the dorsal surface is found in many Trachomedusæ and most Narcomedusæ (Pls. IX.–XIV.); there the tentacles may be placed far up on the exumbrella, but usually denote their original connection with the umbrella margin by the urticating streaks or umbrella clasps already mentioned ("peronia," § 68; Pls. IX., XIII., XIV., *en*). In the Aurelidæ the tentacles are also inserted dorsally (System, taf. xxxii. fig. 8). The Sthenonidæ and Cyaneidæ are distinguished by subumbral insertion of the tentacles; in the latter they are scattered over nearly the whole subumbrella (*Drymonema*, Pls. XXX., XXXI.).

§ 77. Number and position of the tentacles. Although the tentacles of the Medusæ present the most varied conditions both as to number and position, still by critical comparison we are able to recognise the existence of certain simple primary and original conditions, from which all the others may be secondarily derived. We may conclude from this that most probably four perradial tentacles (at the distal end of the four radial canals) represent the primitive formation for the Craspedotæ, but eight principal tentacles (four perradial and four interradial) for the Acraspedæ. In the section of the Craspedotæ tetranemal forms (with four perradial tentacles) are found in all four orders; *Codonium*, *Cytæis*, &c., among the Anthomedusæ, *Tetranema*, *Eucopium*, &c., among the Leptomedusæ, *Petasus* among the Trachomedusæ, *Cunantha* among the Narcomedusæ (comp. System, p. 359); the two latter may, however, be regarded as already octonemal as in them four interradial cordyli alternate with the four perradial tentacles, the cordyli themselves being merely modified acoustic tentacles (§ 84, comp. Pl. IX.). This is also the case in *Pericolpa*, one of the oldest and simplest forms among the Acraspedæ. The inverted condition is shown in *Charybdea* (Pl. XXVI. where the four sense clubs are placed perradially, but the four tentacles interradially. Both the Charybdeidæ (Cubomedusæ) and the Pericolpidæ (Peromedusæ) are derivable from *Tessera*, the oldest and simplest form among the Stauromedusæ, which may at the same time be considered the hypothetic ancestral form of all Acraspedæ. This has already eight principal tentacles (four perradial and four interradial). In *Pericolpa* only the four interridal tentacles are transformed into sense clubs, in *Charybdea* the four perradial, in *Ephyra* (the ancestral form of the Discomedusæ) all the eight principal tentacles. In the latter, as in the closely allied *Nauphanta* (Pls. XXVII., XXVIII.), eight adradial tentacles (fig. B, *ta*) are developed between the eight principal. In the majority of the Medusæ the number of the tentacles increases with age, as new tentacles are formed later between the original four or eight. This increase takes place according to fixed laws, which vary in the different principal groups. The ontogenetic series in the appearance of the different orders of tentacles, allows us to conclude that there is a corresponding phylogenetic progression. In contrast to the eight principal tentacles (four perradial and four interradial) all the others which appear between them later may be termed succursal. This distinction is important because the eight principal tentacles give rise to numerous transformations and progressive formations. By retrograde formation of two opposite perradial tentacles, dissonemal Medusæ, *e.g.*, *Thamnostylus dinema* (Pl. I.) often arise from tetranemal. Such Medusæ are found among many groups of the Craspedotæ, but not among the Acraspedæ. The remains of the retrograded tentacles usually persist as bulbs of the umbrella margin between the two opposite permanent tentacles. On the other hand, we very rarely find only a single tentacle in the developed Medusæ, the three others having undergone retrograde formation; the Euphysidæ, a small sub-family of the Codonidæ (System, taf. ii.) are mononemal Medusæ. The Amaltheidæ among the Craspedotæ, and the Rhizostomæ among the Acraspedæ, are distinguished by complete loss of all the tentacles.

§ 78. Form and structure of the tentacles. In most Medusæ the tentacles are long, cylindrical filaments, more rarely flattened like a ribbon. They are usually thicker at the base, but pointed conically towards the end, more rarely swollen like a club. They are almost always simple and unbranched; only a single family of the Craspedotæ, the Cladonemidæ, are distinguished by branched or composite tentacles (System, taf. vii.); these are sometimes branched dichotomously, sometimes beset with "secondary filaments" (semi-pinnated) as in the Siphonophora and Ctenophora. The structure of the tentacles is essentially the same in all Medusæ. They are composed of the same four essential layers of tissue (or "secondary germinal layers") as the umbrella itself, namely:—(1) the outer epithelium of the endoderm; (2) the muscular plate underlying it, formed of longitudinal fibres; (3) the structureless, elastic supporting plate; (4) the inner cellular axis of the endoderm. We distinguish two principal forms, solid tentacles and hollow tentacles; both often appear in closely allied Medusæ, sometimes beside one another in one and the same species (Geryonidæ). They are principally to be distinguished by the comportment of the endodermal axis. The solid tentacles are usually stiffer and shorter, less extensible and flexible; they are chiefly found in the Trachylinæ (Trachomedusæ and Narcomedusæ) and also in the oldest forms of the Acraspedæ (Stauromedusæ and Cannostomæ). Their cylindrical endodermal axis usually consists of a single row of discoid chordal cells, lying the one above the other like the coins in a rouleau of sovereigns (Pl. VI. fig. 17; Pl. XIII. figs. 5, 6, &c.; Pl. XV.). They are more rarely arranged in several layers (Pl. IV.

figs. 5–8). The hollow tentacles are generally more flexible and movable, longer and much more extensible, they are chiefly found in the Leptolinæ (Anthomedusæ and Leptomedusæ), and also in the majority of the Acraspedæ. They contain a canal, which represents a peripheric process of the gastrovascular system, and is lined by a single layer of endodermal flagellate cells (Pl. VII. fig. 4; Pl. XVII. figs. 15, 16; Pl. XXI. fig. 21, &c.). In the two forms of tentacles, both solid and hollow, the endodermal axis is covered by a structureless elastic supporting plate, which separates it from the overlying muscular plate, and which at the same time acts as antagonist, or elastic extensor against the contractions of the latter. The muscular plate consists of longitudinal muscular fibrillæ, which are usually still connected with the overlying epithelial muscular cells of the ectoderm. The latter, moreover, contains thread cells and feeling cells very variously arranged, and often also glandular cells and ciliated cells.

§ 79. Organs of feeling (tactile organs, "organa palpantia"). As sensibility to variations of temperature, and reaction against touch and pressure is wide spread among the Medusæ, tactile cells ("cellulæ palpantes") must necessarily be generally present. All indifferent sense cells, all ectodermal cells with hair-shaped processes may probably be considered as such. These tactile hairs may be either flexible and movable ("flagellum") or stiff and immovable (tactile bristle, "palpellum"). Whether all ectodermal flagellate cells are to be regarded as tactile cells is still doubtful, but this view probably holds good for the flagellate cells composing the sense-epithelium above the nerve ring of the umbrella margin and the "marginal corpuscules," and also for the flagellate cells, which in many Medusæ form part of the outer epithelium of the tentacles (sometimes arranged in longitudinal streaks, rings or spirals along the sides of the tentacles, sometimes as a connected covering of the ends of the tentacles). We appear more justified in considering these ectodermal flagellate cells as tactile cells, when we perceive that their bases are directly connected with nerve fibrillæ. This is also the case with the "cells with tactile bristles" of the ectoderm, which bear a stiff, often long, and far projecting tactile hair, a tactile bristle or palpellum. Such cells with tactile bristles are usually widespread in the ectoderm both on the exumbral dorsal, and on the subumbral ventral surface, chiefly, however, on the most sensitive parts, on the umbrella margin and the tentacles, and also on the oral margin and the oral arms. According to this view, the whole urticating cells in the first place, and in the second place the "tactile cells" in the more limited sense, or the palpocells (without nematocysts) belong to this category. The "urticating bristle" ("cnidocilium") of the urticating cells, like the feeling bristle ("palpocilium") of the actual "feeling cells," is a direct process of the protoplasm of the cell, projecting externally freely into the water and as in both cases the latter is connected at the base of the cell with nerve fibrillæ, in both cases the stimulation received by the palpellum can also be communicated by the nerves to other parts (muscles, &c.). The urticating cells (with cnidocilia and nematocysts) and the feeling cells (with palpocilia but without nematocysts) are therefore to be regarded as two different modifications of cells with tactile bristles (with palpella). The distribution of these tactile cells on the sensitive organs of the umbrella and its appendages varies remarkably. For example, in the Trachomedusæ and Narcomedusæ special "tactile combs" are found on the umbrella margin, or comb-shaped rows of tactile bristles, tactile rings on the tentacles, and so forth (System, taf. xvii. figs. 9, 10, &c.).

§ 80. Organs of smell ("organa olfactoria"). The peculiar chemical sensillæ of the Medusæ, which might perhaps be equally or more truly termed organs of taste ("organa gustatoria") belong to this category. It is easily seen from physiological observations and experiments that the Medusæ are very sensitive to change of composition of the salt water, and even to slight rarefaction of it, so that, for example, they sink below as soon as it begins to rain. The organs of chemical perception of sense are not yet known with any certainty, and are probably usually represented by sense cells of the umbrella margin, of the tentacles or of the margin of the mouth. Special organs, which give the impression of sensillæ from their situation and composition, may probably also lay claim to this function, such as the marginal clavellæ among the Craspedotæ and the rhopalar olfactory depressions among the Acraspedæ. The "olfactory clubs" or marginal clubs ("clavelli marginales") are only found in the section of the Craspedotæ and there chiefly in the order of the Leptomedusæ. In my System, 1879 (pp. 118, 123, 143, taf. viii. figs. 7, 12; taf. ix. figs. 3, 8) these clavellæ were termed marginal clubs ("cordyli marginales") as they are found in those Leptomedusæ, in which the auditory vesicles, which they therefore perhaps represent, are wanting (Thaumantidæ, Cannotidæ). They usually (or always?) want the characteristic "auditory hairs," which are a distinguishing feature of the acoustic organs. The pyriform or club-shaped clavellus (Pl. II. figs. 3, 4, 8), sits with a thin stalk on the umbrella margin, and is, therefore, not to be confounded with the conical disposition of the young tentacles. It contains a cæcal, very narrow "canalis clavellaris," which runs out from the coronal canal and is lined with high cylindrical epithelium (Pl. II. fig. 8, *y*). The latter is separated by a thin fulcral plate (*z*) from the flat epitheluim of the ectoderm (*q*). The clavellæ are found in many Thaumantidæ and Cannotidæ on the umbrella margin, scattered in large numbers (often several hundreds), between the tentacles, and may, therefore, be regarded as sensillæ. This is also applicable to the olfactory depressions ("fossulæ olfactoriæ, *oz*) of the Acraspedæ. These appear in the Discomedusæ as small, cæcal funnel-shaped depressions in the dorsal surface of the rhopalar protective scales (or "funnel plates"), and are lined with a many folded sense-epithelium, furnished with long flagella (comp. under the rhopalia).

§ 81. Organs of vision ("organa optica"). Physiological experiments prove easily and with certainty that all Medusæ are more or less sensible to the influence of light and warmth. From analogy with other animals we are justified in the conclusion that the simplest organs of this sensation are the pigment spots ("ocelli"), chiefly those placed on the umbrella margin. They consist partly of pigment cells, partly of optical sense cells or root cells, which belong to the sense epithelium of the dorsal nerve ring. Whilst these ocelli are originally simple centres for the perception of heat, they are developed later on into true light eyes. As experiments showed, it is principally the swollen bases of the tentacles which bear such pigment eyes, and that chiefly in the order of the Anthomedusæ and in those Leptomedusæ which have no marginal vesicles ("ocellatæ"). Such ocelli are more rarely found in the Trachomedusæ, Narcomedusæ, and Stauromedusæ. On the other hand they are widely spread among the three higher orders of the Acraspedæ and usually found at the base of the sense clubs or rhopalia described below. In many Acraspedæ and a few Craspedotæ (Anthomedusæ) a lens is also found in the pigment body of the eye and in the Cubomedusæ a crystalline lens or retina is developed between the lens and the pigment cup. We also find "composite eyes" in the Cubomedusæ, as, *e.g.*, in *Charybdea*, where each sense club bears two large unpaired and two small paired eyes. Moreover, Medusæ perfectly devoid of colour, which have neither marginal ocelli nor other pigment spots, are sensible to light; in this case it is probably the sense epithellium of the umbrella margin which discharges this function. We therefore find in the class of the Medusæ a long series of different phylogenetic stages of development of optical apparatus, from the simplest beginning up to very composite eyes.

§ 82. Organs of hearing ("organa acustica"). In the majority of Medusæ we find organs of sense on the umbrella margin, which must be indubitably regarded as organs of sense as they possess both otolites ("otolithi") and auditory cells ("otocellæ") bearing bristles. In the minority of the Medusæ, in which the otolites are absent, it is possible (or rather probable) that a lower degree of acoustic functions are exercised by part of the cells bearing tactile bristles ("palpocellæ") already described. As, on the one hand, we know of no definite morphological distinction between such tactile cells, bearing bristles and auditory cells which also bear bristles, and as on the other hand, the latter must be regarded as merely special modifications of the former, it is possible that many apparently indifferent tactile cells are sensible not only to fluctuations of pressure, but also to vibrations of sound. Considering, however, the immense use which the capacity of hearing must be to the free swimming Medusæ (*e.g.*, the perception of the noise of the tempestuous breakers on nearing the coast), it is most probable that a lower or higher degree of sensibility to sound is generally spread in this class. In this case we must consider the cells with tactile bristles, which are found in the Medusæ devoid of otolites, in the whole of the Anthomedusæ, Stauromedusæ, and also in the Ocellatæ (Thaumantidæ and Cannotidæ) must among the Leptomedusæ be regarded as "lower acoustic organs." All other Medusæ, on the contrary, possess "higher acoustic organs" or true "organs of hearing," consisting of auditory cells and otolites; these are found in all the Acraspedæ (with the single exception of the Stauromedusæ) and in the majority of the Craspedotæ, in all Trachomedusæ and Narcomedusæ, and also in the Vesiculatæ (Eucopidæ and Æquoridæ) among the Leptomedusæ. In the Vesiculatæ, however, the organs of hearing have quite a different structure and a different origin from those in the other groups mentioned, the Vesiculatæ have velar auditory vesicles with ectodermal otolites, whilst all the others have tentacular auditory clubs with endodermal otolites. These two types in the structure of the auditory organs differ so entirely that they require a separate description.

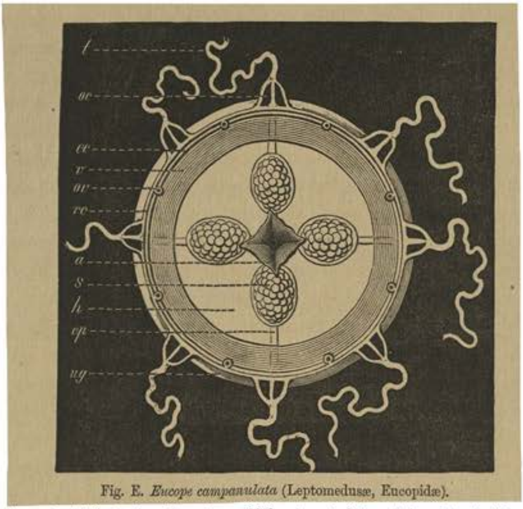


Fig. E. *Eucope campanulata* (Leptomedusæ, Eucopidæ).

Subumbral aspect. (*a*) Quadrate oral opening. (*s*) Ovaries. (*cp*) Perradial canals. (*cc*) Coronal canals. (*v*) Velum. (*ov*) Velar marginal vesicles (adradial). (*h*) Umbrella cavity. (*rc*) Nerve ring. (*oc*) Ocelli at the swollen bases of the tentacles. (*ug*) Gelatinous substance of the umbrella. (*t*) Tentacles.

§ 83. Velar auditory vesicles (with ectodermal otolites, "vesiculæ velares," also termed "marginal vesicles," "vesiculæ marginales," *ov*). This peculiar form of the auditory organs is found exclusively in the order of the Leptomedusæ, and there only in a suborder which we name Vesiculatæ for this reason (the two families, rich in forms, of the Eucopidæ and Æquoridæ, System, taf. x.–xv. pp. 116, 165, 210). The other suborder of the Leptomedusæ, the Ocellatæ (the two families of the Thaumanthidæ and Cannotidæ) have neither otolites nor auditory vesicles, but perhaps auditory cells on the subumbral side of the velum. This exception is supported by the fact, that in the simplest cases in the Vesiculatæ (*Mitrocoma*) no closed auditory vesicles are present, but only open depressions in the insertion of the velum, in whose ectoderm auditory cells and otolite cells are developed. These auditory depressions ("fossulæ velares") are probably found in other Leptomedusæ (*Phialis*, *Tiaropsis*, *Mitrocomella*, &c.), besides *Mitrocoma* (System, taf. x.). They form small depressions in the subumbral or ventral side of the velum (which is commonly termed the "lower" side but which is the "upper" in the normal position of the horizontally stretched velum). One portion of the subumbral ectoderm cells, which line these depressions, and which are connected with the contiguous ventral nerve ring, forms a calcareous otolite in their interior, another portion of it bears an auditory bristle. As these "auditory depressions" become deeper, enter the dorsal side of the velum vaulted like an arch, and finally become entirely loosed from the ventral side, they are transformed into auditory vesicles ("vesiculæ velares"). These project more or less as conical or roundish vesicles on the dorsal side of the velum, near its insertion on the umbrella margin, become innervated from the subumbral nerve ring, covered externally by the dorsal ectodermal epithelium of the velum and contain a hollow space filled with otolymph (originally sea water); this space is lined with an acoustic epithelium, which originally belongs to the ventral ectodermal epithelium of the velum and consists partly of auditory cells bearing bristles and partly of otolite cells. The auditory hairs of the former surround or lie upon the latter. In the most simple cases, each velar marginal vesicle only contains a single otolite, but in others often a large number of them. The inner (subumbral) sense epithelium and the outer (exumbral) covering epithelium, are separated by a structureless lamella which belongs to the supporting plate of the velum. The number and distribution of these velar auditory vesicles of the Leptomedusæ varies largely; however, there are always originally eight adradial auditory vesicles, which lie exactly in the middle between the four perradial and the four interradial tentacles (fig. *E*). We never find fewer than eight. In most Leptomedusæ their number is considerably increased, often to several hundreds; we may therefore distinguish two groups of the Vesiculatæ, the Octotessæ, and Polyotessæ, the former having invariable eight velar auditory vesicles, the latter having invariably more than eight (System, p. 117, taf. x.–xv.).

§ 84. Auditory clubs or "cordyli" (*ok*), acoustic tentacles with endodermal otolites. This form of the organs of hearing is by far the most common among the Medusæ, and is found in the majority of the class, in the Trachomedusæ and Narcomedusæ among the Craspedotæ, and also among all the Acraspedæ, with the single exception of the Stauromedusæ. The auditory clubs of all these Medusæ are modified, small acoustic tentacles, containing endodermal otolites, and differing therefore entirely in origin and composition from the velar auditory vesicles of the Leptomedusæ (with ectodermal otolites). In the two sections, the auditory clubs have originated, independently of one another, from the tentacles in an analogous manner, from the solid tentacles in the Craspedotæ, from the hollow tentacles in the Acraspedæ. In the former, it is the chordal cells of the solid endoderm axis, which produce the otolites, in the latter it is the endodermal cells forming the epithelium at the distal end of the tentacle canal. The auditory clubs of the Acraspedæ are, moreover, combined in a peculiar way, with other organs of sense (ocelli, olfactory depressions, tactile plates) and with their surroundings, compose the typical sense clubs or rhopalia, which we shall afterwards consider separately. On the other hand the analogous auditory clubs of the Craspedotæ (of the Trachomedusæ and Narcomedusæ) which often closely resemble the others, appear to be more simple formations (Pls. III.–XIV., *ok*). They resemble perfectly simple, solid tentacles, whose axis consists of a row of a few endoderm cells (usually two to four, more rarely five to ten or more), processes of the inner epithelium of the coronal canal. Either only the last of these or several of them (two to four, rarely more) produce in their interior a calcareous concrement, which functions as an otolite. The Trachomedusæ (and a small part of the Narcomedusæ, the Solmaridæ) have only a single round otolite in each auditory club; it is in concentric layers, usually spheroidal, more rarely elliptical, and often coloured red or yellow. Most Narcomedusæ (all, indeed, except the Solmaridæ) possess crystalline otolites of prismatic form (usually several in each auditory club). The acoustic ectoderm epithelium of the auditory clubs is separated from the solid endoderm axis by a thin supporting plate, and bears long stiff auditory hairs; so is the ectoderm of the "auditory pad" or "auditory papilla," which in many Narcomedusæ arises at the base of the auditory club by a swelling of the dorsal nerve ring; the latter always supplies the cordylus. In part of the Narcomedusæ (the Cunanthidæ and Peganthidæ) peculiar, firm urticating streaks are found at the bases of the cordyli which rise from these centripetally into the exumbrella, and are covered with ciliated sense epithelium (auditory clasps, "otoporpæ," Pl. IX. fig. 8, *oo;* Pl. XI. fig. 4, *oo*). Four interradial auditory clubs seem usually present originally; the number often increases largely later on, and may amount to more than a thousand (*e.g.*, *Pegantha magnifica*, System, p. 333).

§ 85. Cordylar auditory vesicles ("vesiculæ cordylares"). Whilst in all Narcomedusæ, and also in the lower and older groups of the Trachomedusæ (Petasidæ, Pectyllidæ, Pls. III.–VIII., Aglauridæ), the auditory clubs stand freely on the umbrella margin, in some of the younger and higher groups of the Trachomedusæ, this is rarely the case, and then only in the young stage. The originally free auditory clubs become enclosed in special "auditory vesicles." In the Marmanemidæ (System, taf. xvii.) this is caused by the ectodermal epithelium of the dorsal nerve ring rising like a wall, in the form of a circular fold, at the base of the free cordylus; its margins grow together above the depression formed, and so transform it into a closed vesicle; the auditory hairs are stretched like harp strings between the inner wall of the vesicle and the upper surface of the cordylus enclosed. Whilst these "auditory vesicles" of the Marmanemidæ lie freely on the umbrella margin, the similarly constructed auditory vesicles of the Geryonidæ lie deeply inserted in the gelatinous body of the umbrella margin. These cordylar auditory vesicles of the Marmanemidæ and Geryonidæ therefore differ entirely both in origin and in finer structure from the "velar auditory vesicles" of the Leptomedusæ (§ 83) with which they were formerly usually confounded.

§ 86. Sense clubs ("rhopalia," *or*). We designate by this name the peculiar, "composite organs of sense," or "marginal bodies" of the Acraspedæ, which are always universal in this section, and only wanting in the lowest and oldest Acraspedæ, the Stauromedusæ. In place of rhopalia the Stauromedusæ have simple tentacles, and it seems undeniable from their whole structure, situation, and distribution that the rhopalia of the Acraspedæ are modified tentacles furnished with several different organs of sense. If we assume that the Tessera, the simplest and oldest among the known Acraspedæ, is the common ancestral form of this section (or at least does not differ essentially from the hypothetic ancestral form), the characteristic position of the sense clubs in three higher orders of the Acraspedæ is explained as follows:—Of the eight principal tentacles of Tessera the four interradial are transformed into rhopalia in the Peromedusæ (Pls. XVIII., XIX.), and the four perradial in the Cubomedusæ (Pl. XXVI.), whilst the four tentacles alternating with them remain unaltered. In the Discomedusæ, on the other hand, all the eight tentacles of Tessera have become sense clubs; in fact the majority of the Ephyroniæ have four perradial and four interradial sense clubs (Pls. XXVII.–XXXII.), and it is only in a few genera that their number increases secondarily from twelve to sixteen, rarely from twenty-four to thirty-two (System, pp. 364, 401, 427, 457). As the sense clubs of the Acraspedæ in this section have originated independently, and as even the four perradial rhopalia of the Cubomedusæ have been formed from "acoustic tentacles" independent of the four interradial sense clubs of the Peromedusæ, the former present no homology with the similar auditory clubs or cordyli of the Craspedotæ, but only a close analogy; they are distinguished from the latter by their more composite structure, and also by their protected position in special rhopalar niches (hence Steganophthalmæ). The rhopalar niches ("antra rhopalaria," Pl. XXX. figs. 2–4, *on*) are ectodermal cavities, which lie in most Acraspedæ on the umbrella margin, but which sometimes change their marginal position later on and migrate either on to the dorsal surface of the exumbrella (Cubomedusæ, Pl. XXVI.) or on to the ventral surface of the subumbrella (*Drymonema*, Pls. XXX., XXXI.). The sense niches or sense sinuses are enclosed on both sides, usually on their ventral or axial surface, by the paired "sense-folds," the axially projecting medial margins of a pair of sense lobes of the umbrella margin (rhopalar lobes); these "plicæ rhopalares" (*of*) are sometimes fused into a plate. On the other hand, the unpaired sense scale or protecting scale ("squama rhopalaris," *os*), originating from the marginal bit of the exumbrella, which originally formed a connecting bridge between the two sense folds, projects on the dorsal or abaxial side of the rhopalar niche as a protecting roof. In the convex dorsal surface of the protective scale, there is usually a cæcal funnel-shaped olfactory depression ("fossula olfactoria," *oz*) whose folded sense-epithelium is furnished with special flagellate cells (olfactory cells). The true sense club, which lies hidden in the niche, corresponds to a short, club-shaped hollow tentacle, whose "sense canal" ends in an otolite sac or "crystal sac" (Pl. XXX. figs. 4–7). The latter consists of a considerable, spheroidal or oval accumulation of crystalline concrements, which have been formed in the endoderm cells of the tentacle canal; it is enclosed in a fulcral sheath covered externally by the ectodermal epithelium, beset with long, stiff, auditory hairs. A peculiar tactile plate (?) whose rod-shaped tactile cells bear long flagella, is usually found at the proximal base of the auditory club on the axial ventral side, whilst on the abaxial dorsal side there is a visible pigment pad which is considered as an eye, and sometimes encloses a lens and sometimes not. These eyes appear to attain their highest development in the Peromedusæ and Cubomedusæ, in them we often find several eyes in each rhopalium, in which a crystalline lens and a retina with a large optic ganglion may be developed (System, pp. 401, 427; taf. xxiii., xxv., &c.,).

§ 87. In all Medusæ the muscular system is composed of two different principal sections, a circular, and a longitudinal system of fibres. Both form a thorough contrast, not only by their local distribution and by the direction of the course of their fibres, but also by their histological nature; the circular or transverse fibres are usually clearly striated, whilst the radial or longitudinal fibres are flat for the most part. By far the largest and most important part of the two systems belong to the subumbrella which functions chiefly as swimming organ. The muscular system of the umbrella margin and the tentacles generally proceeds from the subumbrella. On the other hand, the muscular system of the exumbrella, which is only very partially developed, is by no means important. Both the transverse and the longitudinal fibres are exclusively products of the ectodermal epithelium, with which they are still most closely connected (comp. above, §§ 51–53). Moreover, in some (perhaps all?) of the Medusæ, weak (usually very unimportant) muscles which originate from the endodermal epithelium of the gastrovascular system appear on certain parts of the body. Certain circular muscles of the œsophagus and the muscles of the gastral filaments belong to these endodermal muscles, which as yet have been but little recognised and investigated. Although the two sections of the class of Medusæ have originated independently of one another, the differentiation of the muscular system show analogous conditions in both cases. In both the circular and the radial system of fibres we can generally distinguish three sections, of which the first occupies the central and proximal part, the second the middle part (the true umbrella in the more restricted sense), and the third the marginal or distal part (along with the marginal appendages).

Survey of the two muscular systems of the subumbrella.

I. SYSTEM OF CIRCULAR MUSCLES (composed of striated fibres, running transversely or circularly).		II. SYSTEM OF RADIAL MUSCLES (composed of smooth fibres, running longitudinally or radially).	
1. Proximal part of the circular muscular system.	1. "M. orbiculares," oral circular muscles (circular muscles of the œsophagus and the stomach).	1. Proximal part of the radial muscular system.	1. "M. proboscidales," proboscis muscles (longitudinal muscles of the œsophagus and of the gastral peduncle.
2. Middle part of the circular muscular system.	2. "M. coronares," coronal muscles (coronal pouches, &c.).	2. Middle part of the radial muscular system.	2. "M. codonoides," muscles of the bell (deltoid muscles, &c.).
3. Distal part of the circular muscular system.	3. "M. velares," velar muscles (circular muscles of the velum and the velarium).	3. Distal part of the radial muscular system.	3. "M. marginales," marginal muscles (longitudinal muscles of the tentacles and the marginal lobes.)

§ 88. Circular muscles of the subumbrella ("myosystema circulare"). The circular muscular system of the subumbrella is developed quite analogously in the two sections of the Medusæ class, and consists of transversely-striated muscles, running in horizontal transverse planes (perpendicularly to the principal axis). This system is divided into three different sections,—the proximal circular muscle of the œsophagus and the oral organs ("musculus orbicularis"), middle coronal muscle ("musculus coronaris"), and the distal circular muscle of the velum ("musculus velaris"). The circular oral muscle ("musculus orbicularis," *mo*) forms the proximal part of the circular system, and is generally the weakest of its three sections and also the most irregularly developed in the different groups. It only attains any considerable development in such Medusæ as are distinguished by a strong, movable œsophagus, or by large oral lobes or folded oral arms; for example, among the Craspedotæ, on the folded oral lobes of many Anthomedusæ and Leptomedusæ, on the raised lips, capable of extension into a large sucking-disk, of many Trachomedusæ (Pl. III. fig. 2; Pl. V. figs. 3, 4; Pl. VII., fig. 3, *am*); and on the very contractile and extensible œsophagus of many Narcomedusæ (Pls. IX.–XIV.); among the Acraspedæ on the oral lobes of the Stauromedusæ and Cubomedusæ (Pls. XV., XVII., XXVI.); on the buccal pouches of the Peromedusæ (Pl. XX. figs. 9–11), and on the oral arms of many Discomedusæ (Pls. XXX.–XXXII.). The second and middle section of the circular muscular system, the large coronal muscle ("musculus coronaris," *mc*) is much more important. It must be regarded originally in all Medusæ as the most important swimming muscle, and in most of them, it occupies the greater part of the subumbrella, from the distal margin of the orbicular muscle (or in others of the bell-muscle) to the proximal margin of the velar muscle. Its parallel and thickly compacted circular fibres sometimes run as uninterrupted rings on the whole subumbrella, or are sometimes divided by four, eight, sixteen or more radial septa into an equal number of separate plates. The coronal muscle is divided into four interradial plates in a large number of Craspedotæ; into eight adradial, *e.g.*, in the Cubomedusæ (Pl. XXVI.), into eight principal (four perradial and four interradial) plates in *Pericolpa* (fig. F), into sixteen subradial in the Pectyllidæ (Pls. IV., VIII.); in *Periphylla*, on the other hand, eight of the coronal plates are principal, and eight adradial (Pl. XIX.). Very often (namely, in the larger Acraspedæ) the supporting plate rises below the coronal muscle in the form of simpler or more complex circular folds, so that the muscular system lying above it commands a more extensive surface of insertions in a limited space (Pls. XIX.–XXII., *mc*). In most Craspedotæ, the coronal muscle is comparatively broader, and covers the larger part of the subumbrella as connected plates, whilst in most Acraspedæ it is narrower and more limited to their periphery; it is often forcibly thrust back by the deltoid muscles, which extend themselves at its expense (fig. F, *md*). The velar muscle ("musculus velaris") forms the third distal section of the subumbral circular muscular system. In the Craspedotæ it represents the most important element of the velum (Pls. IV.–XIV.) and is separated by the ventral nerve ring from the contiguous distal margin of the coronal muscle. It is represented in the Acraspedæ, by the analogous (but not homologous) coronal muscle of the

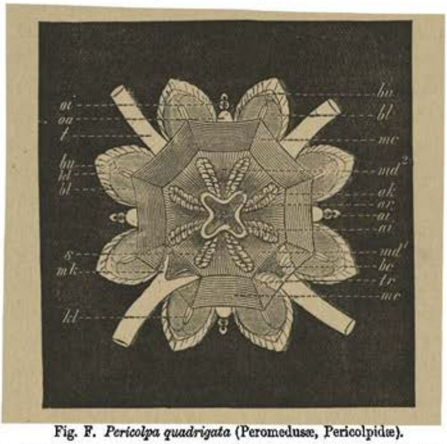


Fig. F. *Pericolpa quadrigata* (Peromedusæ, Pericolpidæ).

Subumbral aspect. (*oi*) Sense clubs (interradial). (*oa*) Ampulla at their bases. (*t*) Tentacles (perradial). (*bl*) Lobe pouches. (*bu*) Horseshoe-shaped canals of the pouches. (*kl*) Peronia between the two limbs of the canal. (*s*) Genitalia. (*mk*) Root-muscles of the tentacles. (md^1) Perradial deltoid muscles. (md^2) Interradial deltoid muscles. (*ak*) Oral ribs. (*ar*) Oral grooves on their inner surface. (*ai*) Oral tæniola. (*tr*) Tentacle roots. (*bc*) Coronal pouches. (*mc*) Coronal muscles.

velarium; it is most strongly developed in the Cubomedusæ (Pl. XXVI., *mv*). Comp. §§ 66–70.

§ 89. Radial muscles of the subumbrella ("myosystema radiale"). Whilst the circular muscular system of the Medusæ is almost invariable composed of transversely striated fibres, the radial muscular system in both sections of this class, is formed for the most part of smooth, not transversely striated, muscular fibres; these run in vertical meridian planes, sometimes more radially, sometimes more longitudinally, parallel to the principal axis. The radial muscular fibres are also divided into three sections analogous to those of the circular muscular fibres; the proximal longitudinal muscles of the œsophagus and of the oral organs, and also of the gastral peduncle ("musculi proboscidales"), the middle bell muscle ("musculus codonoides"), and the distal longitudinal muscles of the umbrella margin ("musculi marginales"). The system of the proboscidal muscles ("musculi proboscidales") forms the proximal part of the radial system; we may include in it, the true longitudinal muscles of the œsophagus and of the different oral organs (oral lobes, oral arms), and also the longitudinal muscles of the gelatinous gastral peduncle (*e.g.*, in the Octorchidæ System, taf. xii., xiii.; Geryonidæ, System, taf. xviii.); in proportion as the gastral peduncle is developed as a movable "proboscis," the four, six, or eight broad longitudinal bands of muscles, which run in its upper surface between the ascending radial canals, become more powerful. Of the longitudinal muscles of the œsophagus itself the four perradial are usually most strongly developed. They run on the four folded oral lobes or the large oral arms which have originated from them, on the abaxial side of their midrib, and radiate, often in bunches, towards their frilled oral margin. In most Medusæ the second and middle section of the radial muscular system, whose separate part we include under the name of bell muscles, is far more important. All the longitudinal muscles of the subumbrella which lie between the base of the "proboscis" and the umbrella margin belong to it. The bell muscle (like the coronal) not unfrequently (namely, in a part of the Narcomedusæ and Stauromedusæ) represents a single, bell-shaped, arched muscular plate, consisting of diverging radial fibres; it is usually divided into a number (four, eight, sixteen, or more) of separate longitudinal muscles. In most Craspedotæ four or eight such longitudinal muscles run on the subumbral surface of the radial canals, but often also four or eight in the middle between these. We consequently find usually four perradial longitudinal bands (*mp*) and four interradial (*mi*) between them, beside often eight adradial, rarely more. They are sometimes simple, unpaired bands, which run exactly in the middle line of the radial canals (*e.g.*, Pectyllidæ, Pls. III.–VIII.), sometimes paired bands, enclosing the two lateral margins of the canals (*e.g.*, Tiaridæ, System, taf. iv. figs. 2, 3). The subumbral radial muscles are most strongly developed in those Craspedotæ which form circumoral buttresses (mesenteries or mesogonia). Many Tiaridæ have four such perradial mesenteries, whilst the Pectyllidæ have eight principal mesenteries (Pl. IV. fig. 3, Pl. VIII. fig. 9, *wr*). They lie as four or eight thin, broad leaves in the principal radial planes, and run in the umbrella cavity, stretching freely from the subumbrella to the œsophagus; their longitudinal muscular fibres ("musculi mesenteriales") pass into the proboscis muscles, at the proximal margin of the mesogonia. Among the Acraspedæ the bell muscle of the Cubomedusæ usually comports itself like that of the Craspedotæ (Pl. XXVI.; System, taf. xxv. xxvi.). The subumbrella of the Tesseronia is on the whole almost cubical; its coronal muscle consists of four broad quadrangular(often almost quadrate or rectangular) muscular plates, which touch at right angles in the interradii. They are divided by four narrow, interradial longitudinal muscles, running along the four cathammal septa, but are halved in the middle by four broader perradial longitudinal muscles; the latter pass below upon four "frenula velarii" (Pl. XXVI. fig. 8, *vf*), above upon the mesenteries which run to the four corners of the stomach (Pl. XXVI. figs. 2, 3; System, taf. xxvi. figs. 2, 3, *gm*). In the remaining Tesseronia (both in the Stauromedusæ and the Peromedusæ) the three strong, broad triangular deltoid muscles (Pls. XV.–XXII. *md*) occupy the place of these narrow, band-shaped longitudinal muscles. The deltoid muscles spring with a broad base at the proximal margin of the coronal muscle (*mc*), and run with converging fibres towards the bottom of the umbrella cavity (fig. F, *md*). The four interradial deltoid muscles (*md*) are usually considerably stronger than the four perradial (*md*); the former are inserted at the four interradial cathammal nodes (*kn*), and often pass out above them as "intergenital muscles" (Pl. XX. fig. 8, *ms*); the latter are inserted at the four perradial palatine nodes (*gk*), and pass from them upon the mesenteries and the corners of the œsophagus. In the Ephyroniæ or Discomedusæ, those parts of the bell muscle appear much less important than in the Tesseroniæ, which is accounted for by the retrograde formation of the four perradial pouches, and by the extension of the broad umbrella corona. The eight deltoid muscles (and especially the four interradial) are pretty strongly developed only in a few Cannostomæ (as in *Atolla*, Pl. XXIX. fig. 3, and *Nauphanta*, Pl. XXVIII. fig. 12), whilst in most Discomedusæ they have undergone retrograde formation. We may therefore regard the four strong pillar muscles of many Semostomæ and Rhizostomæ as developments of the four perradial deltoid muscles; they pass at their proximal end into the four perradial proboscis muscles. The system of the marginal muscles ("musculi marginales") forms the third and distal section of the radial muscular system. Under the term "marginal muscles" we include all the longitudinal or radial muscles which are developed on the umbrella margin outside the circular coronal muscle. They are differentiated in many varied ways. The most important are the muscles of the tentacles and of the marginal lobes. The muscular fibres of the tentacles all run longitudinally in a great variety of arrangements.

§ 90. Muscular system of the exumbrella. Development of the muscular system appears entirely wanting on the upper or exumbral surface of the umbrella, when contrasted with its powerful and universal development on the lower or subumbral surface.

Closer investigation, however, shows that muscles are also developed here in some places, though but feebly, at least in some groups of Medusæ (perhaps in all ?), and then into both transverse and longitudinal cords of fibre. The principal exumbral circular muscles are the feeble zonal muscles ("musculi zonares," *mz*) which are found in some Craspedotæ above the umbrella margin, in others in the circular stricture between the umbrella and the apical process (*e.g.*, *Catablema*, System, taf. iv. fig. 4). They are more strongly developed in some Acraspedæ as, for example, in the visible zonal muscle of the Peromedusæ which divides the smooth umbrella cone from the pedal zone of the umbrella corona and sends out zigzag processes between its pedalia (Pl. XXIII. fig. 34, *mz*; Pl. XXIV. fig. 2, *mz*). Exumbral radial muscles are found in some groups (especially in the Trachomedusæ and Narcomedusæ), developed on the umbrella margin into peronial muscles ("musculi peroniales," Pl. XIII. fig. 7, *ml*; Pl. XIV. fig. 12, *ml*). Other, but feebler, longitudinal muscles appear in both sections here and there on the umbrella apex and on other places of the convex outer umbrella surface. Among the Craspedotæ, four perradial and four interradial longitudinal muscles are found in the peripheric (and sometimes also in the central part) in some Anthomedusæ; and among the Acraspedæ, in the Cubomedusæ. The longitudinal muscular bands of the tæniola and the strong peduncle muscles of the Stauromedusæ, also belong to this system (Pls. XVI., XVII. figs. 13, 14, *m*).

§ 91. Umbrella cavity or swimming cavity ("antrum, caverna umbralis," *h*). The umbrella cavity of the Medusæ is as characteristic for this class of urticating animals as the umbrella itself; it is enclosed above by the lower concave surface of the umbrella ("subumbrella"), whilst it opens freely below through the aperture of the umbrella cavity ("apertura antri"). The subumbral umbrella cavity is more or less vaulted, according as the umbrella is more umbrella shaped or more conical; its vaulted roof, which is lined by the ectoderm of the subumbrella, is, however, always flatter than the outer surface of the umbrella which is covered by the ectoderm of the exumbrella, for the gelatinous wall of peripheric umbrella corona is always thinner than the central umbrella cone. As by each contraction of the swimming Medusæ, the vaulting of the umbrella cavity becomes higher, its opening narrower, and water is ejected through the opening, whilst by each dilatation of the umbrella fresh water enters the flattened and widened umbrella cavity, the latter may be regarded physiologically both as a "swimming cavity" and a "respiratory cavity." The ectodermal epithelium of the subumbrella, which lines the umbrella cavity, is probably adapted for respiratory functions. The opening of the umbrella cavity ("apertura antri") is simple and surrounded by the corona of lobes in the Acraspedæ, whilst in the Craspedotæ it is narrowed by the velum, which projects freely inwards like a diaphragm, from the umbrella margin. In some Craspedotæ the velum is so broad, that it is probably capable of completely closing, for a while, the opening of the umbrella cavity, as in the Pectyllidæ (Pls. III.-VIII.). The central axial space of the subumbrella is occupied more or less by the œsophagus and the different organs of buccal stomach and also often by the genitalia.

§ 92. Niches of the umbrella cavity ("cavernulæ subumbrales"). In many Medusæ special secondary spaces are developed on the subumbral wall of the umbrella cavity, partly by the formation of folds or projections of the subumbrella, partly by the insertion of single organs into pit-like depressions and partly by peculiar conditions of growth of the umbrella margin and the "marginal bodies" lying on it. All these different secondary cavities of the umbrella cavity may be placed together as "niches of the umbrella cavity or subumbral niches" ("cavernulæ subumbrales"). In many Narcomedusæ, namely the Peganthidæ, the cavity of the umbrella corona is divided into a peripheric corona of separate "lobe cavities" ("cavernulæ lobares"), which surround the central umbrella cavity like the altar niches of a round temple (*Pegantha pantheon*, p. 37, Pls. XI., XII.). In *Pectis*, eight adradial "oral funnels or inner buccal pouches" ("cavernulæ buccales") are invaginated from outside into the œsophagus (p. 15, Pls. IV., V. figs. 4, 5, *io*). In many Cubomedusæ and Peromedusæ, namely, the Periphyllidæ, each tentacle is surrounded at its base by a subumbral tentacle funnel ("cavernula tentacularis"), over which the distal margin of the subumbral coronal muscle projects like a roof. In *Periphylla* (Pl. XIX. fig. 6, Pl. XX. fig. 8) it is simple; in *Periphema* (Pl. XXIV. fig. 1) it is divided into secondary funnels by a number of small frenula. In many Cubomedusæ, four perradial triangular subumbral folds pass as "frenula velarii" from the base of the sense niche and the vertical septum of the marginal pouches to the subumbral surface of the horizontal inwardly projecting velarium (Pl. XXVI. figs. 2, 3, 8, *vf*), so that two small velar niches ("cavernulæ velares") are inserted on each side of the velarium. In most Discomedusæ eight (more rarely sixteen) sense niches are formed on the umbrella margin for the reception of the sense clubs or rhopalia ("antra rhopalaria," comp. above, § 86). In some species, *e.g.*, in *Drymonema*, these stretch centripetally far into the subumbrella (Pls. XXX., XXXI., *on*).

§ 93. Coronal cavity of the umbrella and funnel cavity of the umbrella. In some Craspedotæ, or in many Acraspedæ, four or eight vertical folds of the subumbrella, the mesenteries ("mesenteria") are developed in the bottom of the umbrella cavity at the base of the œsophagus, and the upper part of the simple umbrella cavity is thus divided into four or eight separate cavities, the umbrella funnels or funnel cavities ("infundibula," *i*). We therefore term the lower, simple half of the umbrella cavity, which opens freely below at the umbrella margin, the coronal cavity of the umbrella ("antrum coronare"), and the upper quadrilocular or octolocular half as the funnel cavity of the umbrella ("antrum infundibulare"); the former communicate with the latter by four interradial or eight adradial funnel openings ("ostia infundibularia").

§ 94. Funnel cavities and mesenteries ("infundibula and mesenteria"). The four or eight funnel cavities or umbrella funnels ("infundibula," *i*), which compose the umbrella funnel cavity of many Medusæ, are hollow spaces, more or less conical and lined by the ectoderm of the subumbrella; they are always cæcal in the aboral bottom of the umbrella cavity, whilst they open into the coronal cavity of the umbrella by the roundish funnel openings (" ostia infundibularia "). The adjacent funnels are separated by thin vertical septa, the mesenteries (" mesenteria " or " mesogonia," *wr*). In one group only, the Pectyllidæ (Pls. III.–VIII.), there are eight mesenteries present (four perradial and four interradial) between eight adradial funnels. Otherwise there are invariably only four perradial mesenteries between four interradial funnels. The mesenteries or mesogonia are formed by the four perradial oral corners extending, like wings, in the bottom of the umbrella cavity and rising in the form of thin folds of the subumbrella. The further these folds pass towards the outside on the subumbral surface, and the further they pass downwards on the oral corners, the deeper are the intermediate funnel cavities. In the Craspedotæ, the mesenteries are always thin, delicate membranes, which serve chiefly for fixing the œsophagus (*e.g.*, among the Anthomedusæ in *Tiara* and *Turris*, System, taf. iii., iv.; among the Trachomedusæ in *Pectyllis* and *Pectanthus*, Pls. IV., VIII.). In the Acraspedæ, on the other hand, the mesenteries are often hollow, as the central gastral cavity arches into them like pouches, especially in part of the Lucernaridæ ("mesogonial pouches," " bursæ mesenteriales "). The funnel cavities are usually flat and insignificant in the Cubomedusæ (Pl. XXVI.), but very large and deep in the Peromedusæ. In the Periphyllidæ (Pl. XXI. figs. 12, 13, *ib*), they even ascend as far as the point of the umbrella cone, so that they touch the four interradial tæniola, in the centre point of the basal stomach (Pl. XX. fig. 8, *ib*). In such a case, the funnels hollow out the entire length of the four interradial tæniola, so that these solid ridges are transformed into hollow cones. The four interradial funnel cavities are peculiarly modified in the Discomedusæ, where they obtain special importance as "respiratory cavities" or " subgenital cavities."

§ 95. Subgenital cavities (" demnia," otherwise also called " respiratory cavities," " genital cavities," " umbrella cavities of the reproductive organs," " infundibula subgenitalia "). These four peculiar interradial cavities are only found in the order of the Discomedusæ, where they are in part developed and transformed into peculiarly shaped hollow spaces. Fundamentally they are merely subumbral funnel cavities, which have acquired a varied form and function by special adaptation (namely in their relations to the genitalia). Whilst in the three orders of the Tesseroniæ, the four funnels usually rise as slender, hollow cones, corresponding to the conical or pyramidal form of the high, vaulted umbrella, in the Ephyroniæ or Discomedusæ, on the contrary, they extend on the lower surface of the umbrella, in the form of low pouches, in correlation to its flat discoid shape. In this order the subumbral wall of the flat, wide gastral cavity is, at the same time, the place of origin of the reproductive glands, and forms a delicate thin-walled "gastrogenital membrane" (*gg*), in which the four interradial (in the Cannostomæ sometimes eight adradial) reproductive bands are developed. The gelatinous supporting plate of the subumbrella is often thickened round these genitalia in the form of a firm, cartilage-like subgenital ring ("annulus subgenitalis"). If the genital band increases considerably and the delicate gastrogenital membrane round it becomes folded repeatedly, the latter may undergo a double change of position. It either passes below through the firm subgenital ring, which does not extend in an equal degree, into the umbrella cavity, thrusts itself out like a projecting hernia and so forms four pendant external gastrogenital pouches whose cavities are lined by endoderm ("extraversio gonadum," System, p. 470), as, for example, in the Cyaneidæ (Pls. XXX. XXXI., *gg*) or, reversed, the increasing folded gastrogenital membrane, along with the genitalia attached to it, does not pass through the subgenital ring, but invaginates into the central gastral cavity, like a replaced hernia (as, for example, in the Aurelidæ, System, taf. xxxiii. fig. 7). It then forms four "inner subgenital cavities," lined with the ectoderm of the subumbrella ("introversio gonadum," System, p. 470). These are, however, merely flattened funnel cavities; the "ostium subgenitale," which may be compared to the "hernial opening" ("porta herniæ subgenitalis"), is the narrow opening of the subgenital ring, which leads

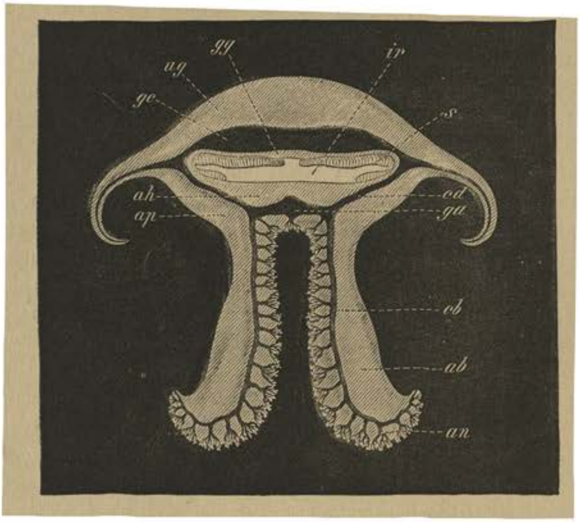


Fig. G. *Cannorhiza connexa* (Discomedusæ, Versuridæ).

Adradial section. (*ug*) Gelatinous umbrella. (*gc*) Central stomach. (*gg*) Bottom of the central stomach (gastrogenital membrane with the genitalia, *s*). (*ir*) Subgenital porticus. (*ah*) Brachiferous plate. (*ap*) Arm pillars. (*cd*) Pillar canals. (*ga*) Buccal stomach. (*ab*) Oral arms (adradial). (*cb*) Brachial canals. (*an*) Funnel frills (sucking mouths).

from the coronal cavity of the umbrella into the four funnel cavities (compare the detailed description in the System der Medusen, 1879, pp. 467–473). Whilst the four subgenital cavities remain separate in most Discomedusæ furnished with them (Tetrademniæ), in part of the Rhizostomæ (Monodemniæ) they are fused in the centre into a single common "subgenital vestibule."

§ 96. Subgenital vestibule ("porticus subgenitalis, syndemnium," *iz*). The peculiar and remarkable hollow space, which we have termed "porticus subgenitalis" (System, 1879, p. 472), is only found in the middle of the subumbrella in two families of the Rhizostomæ, the Versuridæ (System, taf. xl.) and the Crambessidæ (System, taf. xxxviii., xxix.), which we have therefore united into the section of the Monodemniæ. This central subgenital vestibule has arisen from the four interradial, subgenital cavities already described, growing centripetally as far as the middle of the central gastral space, and entering there into immediate communication (Pl. XXXII., and woodcut, fig. G). The delicate gastrogenital membranes (*gz*) which form the thin wall of the invaginated subgenital pouches, touch in the central axis of the gastral cavity and become fused together; these points of fusion are then broken through and the four subgenital cavities, which were originally separated, are consequently fused into one. The cruciform central subgenital vestibule formed in this way (Pl. XXXII, fig. 2, *iz*) is completely lined by the ectoderm of the subumbrella, and only opens to the outside by four interradial portals, the "subgenital ostia" (figs. 1, 7, *ig*). Its upper wall or the vestibule roof ("paries porticus gastralis") is formed by the delicate gastro genital membrane (*gg*) which separates it from the overlying gastral cavity (*gc*) and bears the four genitalia (*s*); its lower wall, or the "vestibule floor," is formed by the peculiar brachiferous disk ("discus brachiferus") from which the eight adradial oral arms of the Rhizostomæ depend, and in the middle of which below we find the suture of the oral cross (Pl. XXXII., figs. 2, 6, 7, *ah*). The two walls are only connected by the four perradial vestibule pillars ("pilastri," *ap*). These are four strong gelatinous columns, placed between the four narrower or wider subgenital openings. The four simple pillar canals (fig. 2, *cd*) which represent the only connection between the upper central stomach (*gc*) and the lower buccal stomach (*ga*) along with the arm canals (*eb*) proceeding from it, run perradially upwards in these columns.

IV. GASTROVASCULAR SYSTEM OF THE MEDUSÆ.

§ 97. Composition of the gastrovascular system. Of the two large organic systems composing the body of the Medusa, the gastrovascular system includes the complex of the vegetative organs, the apparatus for nutrition and reproduction, and is, therefore, physiologically opposed to the neurodermal system, which forms the complex of the animal organs. This antithesis is shown histologically in relation to the two primary germinal layers, as the majority and more important parts of the gastrovascular system originate from the endoderm (or "vegetative germinal layer"), whilst those of the neurodermal system, on the contrary, originate more usually from the ectoderm (or "animal germinal layer"). The apparatus of nutrition, formed by the principal intestine (stomach along with the oral organs) and the radial coronal intestine proceeding from it (vascular corona or pouch corona), is by far the more considerable and widely differentiated of the two apparatuses composing the gastrovascular system. The apparatus of reproduction is much simpler and less differentiated; it consists solely of the sexual glands or genitalia, which are developed in the subumbral wall of the gastrovascular system.

§ 98. Hollow space and walls of the gastrovascular system. The entire gastrovascular system of the Medusæ, in spite of its numerous and important modifications in different groups, shows everywhere one and the same essential type of formation. It appears everywhere as a more highly developed formation of that simple gastral hollow space, which is met with in the lowest polyps (*Hydra*, *Clava*, &c., among the Hydropolyps; *Scyphostoma*, *Spongicola*, &c., among the Scyphopolyps). The primitive, perfectly simple gastral cavity of these oldest polyps is nothing more than the original primitive intestine ("archigaster, archenteron") of the gastræa, which still forms the common ontogenetic base for the intestinal system in the gastrula of all Metazoa; its simple opening is the primitive mouth ("archistoma, blastoporus). We distinguish the two walls of this primitive intestine of the polyps as the aboral calyx wall ("paries calycinalis, calyx") and the oral peristomal wall ("paries peristomalis, peristomium"); the two pass immediately the one into the other at the margin of the calyx ("margo calycinalis"). In the Medusæ, the notumbrella corresponds to the calyx on the one hand and the cœlumbrella to the peristomium on the other; we, therefore, term the calyx wall of the gastral space the dorsal wall ("paries umbralis" or "dorsalis") and the opposite inner or peristomial wall the ventral wall ("paries subumbralis" or "ventralis"). The endodermal epithelium of the former is always formed of small flat flagellate cells, that of the latter of large high flagellate cells (§ 47).

§ 99. Principal intestine and coronal intestine ("axogaster et perogaster"). In all Medusæ the gastrovascular system or intestinal system is divided first of all into two different principal sections, into a central and a peripheric part. For brevity we shall term the former the principal intestine, and the latter the coronal intestine. The central principal intestine ("gaster principalis, axogaster") is simple and undivided, its axis is at the same time the principal axis of the whole body, the umbrella cone (or centre of the gelatinous umbrella disk) lies at its aboral pole, the oral opening, at the oral pole. The peripheric coronal intestine ("gaster coronaris, perogaster"), on the other hand, is always divided by radial septa (or cathamma), into four or more radial cavities (pouches or canals). The ideal, circular or polygonal boundary line between the principal intestine, and the coronal intestine is consequently defined by the proximal ends of the septa or cathamma; the gastral openings ("ostra gastralia," *go*) lie between them. These narrow or wider fissures are the only openings by which the central principal intestine communicates with the divisions of the radially divided coronal intestine.

§ 100. Cathamma or fused parts. (Fusions of the two walls of the umbrella or of the dorsal and ventral umbrella; septa of the gastrovascular system). The only essential difference between the more simple gastrovascular system of the polyps, and the more composite system of the Medusæ derived from them, consists in this, that the peripheric part of the latter is divided by radial septa into a number, four at least, of radial divisions (pouches or canals). These radial pouches and radial canals were formerly erroneously supposed to be collective evaginations of the central gastral cavity, which had grown from its margin into the solid peripheric part of the umbrella. Now we know that these radial hollows have rather arisen from the fusion at definite points (and first of all, at four interradial points) in the periphery of the simple gastral space of its two walls (the umbral dorsal wall and the subumbral ventral wall). These concrescentiæ or cathammata (*k*) form the radial septa of the peripheric gastrovascular system, between which the remains of the originally simple cavity remains open. Corresponding to the origin of these septa or cathamma is a double, narrow, fused layer of endoderm cells, the cathammal plates are found originally in the middle of their solid gelatinous mass.

§ 101. Cathammal plate ("lamina cathammalis," *dk;* endoderm lamella, gastral fused plate, vascular plate). The "endoderm lamella," which on account of its origin and meaning we term cathammal plate, remains intact in all Medusæ in the interior of the cathamma or septa, and keeps up continous connection between the hollow spaces of the gastrovascular system, separated by the septa. The cathammal plate consists originally of a double layer of endoderm cells (Pl. XXV. figs. 8, 10); the outer or abaxial layer (the "umbral endoderm lamella," du^2) belongs to the dorsal epithelium of the coronal intestine, and originally lined the concave inner surface of the notumbrella (figs. 8, 9, *ug*), whilst the inner or axial layer (the "subumbral endoderm lamella," dw^2) belongs genetically to the ventral epithelium of the coronal intestine, and formerly covered the convex outer surface of the cœlumbrella (figs. 8, 10, *zw*). Sometimes (as for example, very distinctly in the firm septal nodes of the Peromedusæ, Pl. XXV. fig. 8, 10), both layers of the cathammal plate remain distinct during the life of the Medusæ, and can even be artificially separated (by suitable pressure) in fine transverse section. This is however not usually the case. Only a single thin layer of cells is generally visible in the connective tissue of the cathamma, as the two endoderm plates, which were originally separate, have become completely fused together. A considerable hardening and thickening of the two connective plates usually takes place in the cathamma on both sides of the endoderm plates, and the soft gelatinous tissue is sometimes even transformed into true firm fibrous cartilage (Pl. XXV. figs. 8, 10, *wg*^{2}, *zw*^{2}).

§ 102. The three principal forms of the cathamma (*k*). The fusion of the two walls of the gastral space, which give rise to the cathamma or septa, may appear in three principal forms, according as they take place in a point, a line, or a surface. In all three cases the original number of the cathamma amounts to four, and these four primary septa lie interradially (in the middle between the four primary tentacles), whilst the four primary radial cavities separated by them lie perradially (in the same meridian planes as the four primary tentacles). The number of the cathamma may, however, be considerably increased secondarily (corresponding to variations of the homotypical fundamental numbers already mentioned, §§ 23–26). In the most simple case when the concrescence takes place in four points, four septal walls are found ("nodi cathammales," *kn*) as in part of the Stauromedusæ and in all Peromedusæ. The peripheric hollow space of the gastrovascular system then appears as a large coronal sinus ("sinus coronaris"), whose division into four is only indicated by the four small nodes (Pls. XV., XX., XXV.). In the second case, when the fusion takes place in four lines, four septal ridges ("limites cathammales," *kw*) are found as in most Stauromedusæ, all Cubomedusæ, and part of the Discomedusæ (Cannostomæ, and half of the Semostomæ, Pelagidæ, and Cyaneidæ); the peripheric hollow space of the gastrovascular system then forms four radial pouches ("bursæ radiales"), which are separated by the narrow ridges (Pls., XVI., XVII., XXVI.). In the third case, when the fusion takes place in four surfaces, four septal plates ("tabulæ cathammales," *kt*) are formed; as most Craspedotæ, and among the Acraspedæ, in part of the Discomedusæ (in half of the Semostomæ: in the Flosculidæ, and Ulmaridæ, and in all the Rhizostomæ) (Pls. I., II., XXXII.).

§ 103. Cathammal fissures ("antra septalia"). In the order of the Anthomedusæ (and in this only) there appears frequently, if not universally, a partial dissolution of the cathamma, and consequently a local separation of the two fused umbrella walls, by which the peculiar cathammal fissures or septal cavities of these Craspedotæ are originated. In all the cases hitherto observed, they appear as eight adradial cavities, which are completely closed, and contain a gelatinous fluid. They occupy the greater part of the subumbrella, are limited below by the umbrella margin, above by the base of the œsophagus, and are separated from one another by the eight band-shaped longitudinal muscles of the subumbrella, of which four run perradially on the axial side of the four radial canals, and four interradially between the latter (Pls. I. fig. 2, *mi*). The abaxial wall of the cathammal fissures is formed by the thin cell layer of the dorsal endoderm lamella, which lies on the concave inner surface of the notumbrella, whilst its axial wall is formed by the supporting plate of the cœlumbrella, of which the ventral endoderm lamella is lost. The septal cavities are remarkably developed, for example, in *Codonium* and *Sarsia* among the Codonidæ, in *Tiara* and *Catablema* among the Tiaridæ, in *Cytacis* and *Rathkea* among the Margelidæ, &c. They have been hitherto erroneously regarded as cœlome fissures, and placed along with the true body cavity ("cœloma") of the higher animals. Such a cavity does not, however, exist in the Medusæ any more than in other urticating animals. The septal cavities of these Anthomedusæ rather arise from the two fused cathammal plates between the eight principal radial lines becoming parted secondarily, and only remaining fused in these eight lines. From this we see most clearly that the cathammal plates pass continuously into the endoderm layer of the radial canals, where these touch the lateral margins of the septal cavities. On the other hand, the cathammal plates are completely separated from the ectoderm of the umbrella, externally by the gelatinous body of the notumbrella, internally by the supporting plate and muscular plate of the cœlumbrella.

§ 104. Gastrovascular system of the Craspedotæ and Acraspedæ. The two sections of the class Medusæ show differentations, which are perfectly analogous, in the formation of their gastrovascular system, but still present, in spite of all similarity, a constant and therefore very essential difference. In all the Acraspedæ, movable gastral filaments ("filamenta gastralia"), or "internal gastral tentacles," are found on definite places, whilst these are never present in the Craspedotæ. In the Acraspedæ there are at least four of these gastral filaments, which are regularly distributed interradially. They are, however, generally very numerous (usually over a hundred, often over a thousand), and arranged in such a manner as to form four interradial groups of filaments ("phacelli"). The movable filaments of these phacelli are sometimes arrayed in a single row, sometimes in several rows; they are sometimes simple, sometimes branched, and always consist of a solid, cylindrical or band-shaped gelatinous filament (a process of the fulcrum) covered with endodermal epithelium. The phacelli of the Acraspedæ (or "Phacellotæ") are, therefore, of great phylogenetic importance, as indications of them already exist in the polyp nurses of this section. The Scyphopolyps, from which the Acraspedæ are descended, have all four interradial gastral ridges or gastral tæniola on the inner surface of the wall of the stomach, and from these the "filaments" of the "Scyphomedusæ" are developed.

§ 105. Tæniola or gastral ridges ("tæniola gastralia," *ft*). The phylogenetic hypothesis (§ 6) that the two sections of the class Medusæ have arisen independently of one another from two different groups of polyps is fundamentally supported by the fact that the important difference in their gastral formation mentioned above (their being with or without gastral filaments) is already present in the corresponding sections of the class Polypi, from which the Medusæ are descended. The lower Hydropolyps (from which the Craspedotæ or Hydromedusæ) are descended, never possess the four characteristic interradial tæniola of the Scyphopolyps, although similar longitudinal ridges of the inner gastral wall (more irregular in number, form and position) are also found in some Craspedotæ (Tubulariæ, &c). On the other hand, the higher Scyphopolyps from which the Acraspedæ (or Scyphopolyps) are descended, are all originally distinguished by the presence of the four interradial tæniola (also called "gastral walls, mesenteric swellings, longitudinal ridges, longitudinal walls, longitudinal swellings of the inner gastral wall"). These longitudinal gastral ridges (which are also universal among the corals as the so-called mesenteric filaments or mesenteric bands, more properly "gastral bands"), appear originally in the Scyphopolyps as four interradial rib-like thickenings of the gelatinous supporting plate or fulcral lamella; they project from the inner surface of the gastral wall freely into the gastral cavity, and in this way divide its peripheric hollow space into four perradial niches or grooves (Pl. XV. figs. 2, 3, 7, 8, *ft*; Pl. XVII. figs. 13, 14, *ft*). They usually contain a longitudinal muscle (Pl. XVII. fig. 13, *m*) and are always covered by endodermal epithelium.

§ 106. Dorsal and ventral tæniola ("tæniola notumbralia" and "cœlumbralia"). As the tæniola or gastral ridges of the Scyphopolyps are developed over the whole extent of their gastral surface and originally (in *Scyphostoma*, *Spongicola*, &c.,) run from the aboral to the oral pole, from the foot plate of the peduncle to the margin of the mouth, we must divide them into two principal sections, a notumbral part and a cœlumbral part; these two pass into one another at the peristom margin or calyx margin of the Scyphopolyps (corresponding to the umbrella margin of the Scyphomedusæ). The notumbral or dorsal tæniolum reaches from the aboral base or point of the cone to the peristomial margin or umbrella margin, and is a ridge-like thickening of the calyx or "notumbrella" (covered with dorsal endoderm). The cœlumbral or ventral tæniolum reaches from the peristomial margin to the umbrella margin, and is a ridge-like thickening of the "cœlumbrella" covered with ventral endoderm. The cathamma or septa of the Acraspedæ (*k*) are formed at the points where the two portions of the tæniola, the dorsal and the ventral ridges, come in contact and become fused.

§ 107. Gastral filaments (mesenteric filaments, internal gastral tentacles, *f*). The characteristic "gastral filaments" of the Acraspedæ, which are universally present in them and totally wanting in the Craspedotæ, are originally papillæ or excrescences of the tæniola. We immediately perceive from such Acraspedæ, in which the tæniola persist in their original form (especially Stauromedusæ) that the filaments are originally parts of the tæniola (*Tesserantha*, Pl. XV.; *Lucernaria*, Pl. XVI., XVII). This is also the case in the strobilation of the Discomedusæ, where the separate parts of the four strobila tæniola are immediately transformed into the four primary filaments of the Ephyrula

Medusa which detaches itself from the strobila (fig. A, *fp.*). Corresponding to this origin, each filament consists of a solid (sometimes cylindrical, sometimes flattened) gelatinous filament or fulcral papilla, which is simply a papillose or digital excrescence of the supporting plate of the tæniolum. The endodermal epithelium of the latter passes directly on to the filament and consists partly of flagellate cells, partly of glandular cells (calyx cells) to which thread cells and (perhaps universally ?) delicate muscular epithelial cells are often added (comp. Pl. XXII. figs. 23–26). The movable gastral filaments of the Medusæ are usually simple, more rarely branched dichotomously or even pinnated (Pl. XXVI. fig. F, *f*).

108. Phacelli, or groups of filaments. It is only in the simplest and oldest genera of the Acraspedæ (*Tessera*, System, taf. xxi.; *Ephyra*, taf. xxvii.) that the filamental products of the tæniola are limited to the simple gastral filaments (lying immediately on the four interradial cathammal nodes), and also in the young larvæ of other Acraspedæ, *e.g.*, in the Ephyra larvæ of *Aurelia*, there are at first only four such simple filaments (fig. A, *fp.*). In all other Acraspedæ numerous filaments are present, which form separate "groups of filaments" or phacelli. There are always originally only four interradial phacelli (fig. D, *f*); these have arisen by division of the four originally simple filaments, or by repeated production of filaments from the tæniola. Instead of the four interradial, there are often eight adradial phacelli, which have arisen by bifurcation of the former, and are, therefore, more accurately, four pairs of phacelli. These are usually united in pairs at the proximal end, whilst they diverge at the distal end. The distal division of the eight phacelli is strongest in the Periphyllidæ, where the four

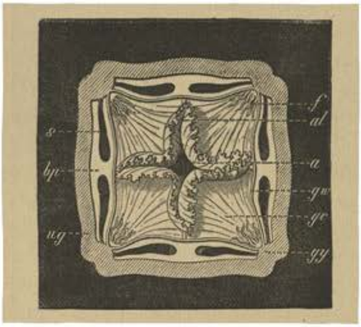


Fig. H. *Procharagma prototypus* (Cubomedusæ, Charybdeidæ).

Horizontal transverse section below the stomach, whose subumbral wall (*gc*) is completely visible, in the middle, the oral opening (*a*) with the four perradial oral lobes (*al*). The gastral filaments (*f*) are placed upon the four interradial pyloric valves (*gy*). (*gw*) Subumbral wall of the two gastral pouches (*bp*). (*s*) Genitalia. (*ug*) Gelatinous substance of the umbrella.

tæniola are hollowed to their aboral ends by the four endodermal conical funnel cavities of the subumbrella (Pls. XXI., XXII.). The phacelli sometimes form straight lines, sometimes arches more or less waved and have often a complicated course as in Periphyllidæ (Pls. XXI., XXII). The tæniola may form phacelli in all the three chambers of the principal intestine; in most Acraspedæ the formation of them is limited to the central stomach. In the Peromedusæ and in some Stauromedusæ, they are strongly developed in the basal stomach, in the Cubomedusæ and Peromedusæ in the buccal stomach: their terminal processes are the barbous filaments of the Peromedusæ (Pl. XX. figs. 9–11, *af*). In the Discomedusæ, the phacelli assume a definite topographical (and perhaps also physiological) relation to the reproductive glands; they lie there on the inner surface of the subumbral gastral wall, on the inner or axial margin of the frill-shaped, folded genitalia, whose winding course they follow.

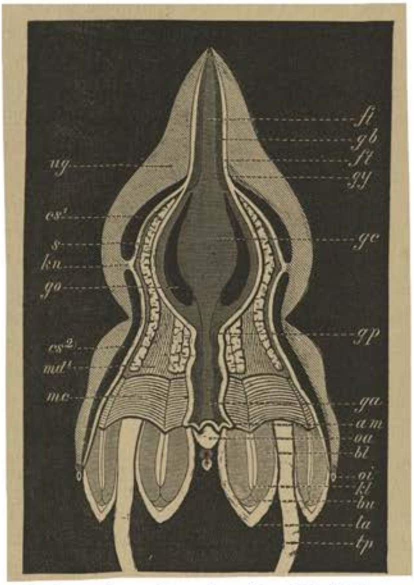


Fig. I. *Pericolpa quadrigata* (Peromedusæ, Pericolpidæ).

Interradial section. (*ug*) Gelatinous umbrella. (*cs*) Coronal sinus (*cs'* proximal part, cs^2 distal part). (*s*) Genitalia. (*kn*) Cathammal nodes. (*go*) Gastral openings. (*md'*) Deltoid muscles. (*mc*) Coronal muscle. (*ft*) Tæniola. (*gb*) Niches of the basal stomach between the tæniola. (*gy*) Pylorus. (*gc*) Central stomach. (*gp*) Palatine opening. (*ga*) Buccal stomach (œsophagus). (*am*) Oral margin. (*oi*) Sense clubs (interradial). (*oa*) Ampullæ at their base. (*bu*) Horseshoe-shaped canal of the marginal lobes (*la*). (*kl*) Peronia between the two limbs of the canal (*bl*). (*tp*) Tentacles (perradial).

§ 109. The three chambers of the principal intestine ("gaster principalis"). The central principal intestine of the Medusæ is rarely perfectly simple, it is usually divided more or less distinctly into two or three sections or chambers, lying one above the other in the principal axis of the body. The lowest of these is the œsophagus or buccal stomach ("gaster buccalis," fig. I, *ga*), which contains the oral opening at the oral pole of the principal axis. The middle chamber is the principal cavity or central stomach ("gaster centralis," *gc*). The third or uppermost section is the peduncle tube or basal stomach ("gaster basalis," *gb*), which ends cæcally at the aboral pole of the principal axis. The central stomach communicates with the basal stomach, below by the palatine opening ("porta palatina," *gp*), above by the pyloric opening ("porta pylorica," *gy*); besides these there are usually gastral openings ("ostia gastralis," *go*), in the lateral walls of the central stomach, by which the latter communicates with the radial chambers of the coronal intestine. All the three stomachs are well developed in many Medusæ of both sections (namely Anthomedusæ and Peromedusæ); the uppermost (basal) stomach has, however, usually undergone retrograde formation. In the majority of Medusæ, the buccal stomach is the longest, the central stomach the broadest of the three chambers, whilst the basal stomach is the smallest or has disappeared. All the three chambers can be already distinguished in many polyps (both Hydropolyps and Scyphopolyps). The buccal stomach of the Medusæ corresponds to the freely projecting proboscis ("tubus oralis") of the polyps, the central stomach to their peculiar "calyx stomach" ("cavitas calycina"), and the basal stomach to their peduncle tube ("tubus peduncularis").

§ 110. Buccal stomach or œsophagus ("gaster buccalis," also termed "tubus oralis, proboscis, manubrium," *ga*). The buccal stomach or œsophagus (*ga*) is the first and lowest of the three chambers of the principal intestine. It is evolved from the "œsophagus" or "proboscis" of the polyps, and shows extraordinary diversity of size, form, and differentiation. It originally bears the oral opening (*aa*) at the oral pole of its vertical axis, whilst it opens at the aboral pole of the axis into the central stomach (*gc*) by the palatine opening (*gp*); the latter is sometimes sharply defined, sometimes indistinct. The palatine opening is usually found in the middle of the subumbrella, so that the œsophagus hangs freely from the latter into the umbrella cavity. In the majority of the Medusæ, the œsophagus is the longest, but not the broadest of the three gastral chambers. It is developed exceptionally strongly in the Anthomedusæ, Trachomedusæ, Peromedusæ, and Discomedusæ, whilst in the other orders it is usually weak or often quite rudimentary. The œsophagus rarely forms a simple cylinder without radial division (as in the Codonidæ, System, taf. i., ii.; and in many Narcomedusæ, System, taf. xix. xx.). In the majority of Craspedotæ, and in all Acraspedæ, the œsophagus is prominently quadrilocular, as the four perradial buccal ribs ("costæ orales," *ab*) have a tendency to centrifugal growth, project towards the outside, and become prolonged into the midribs of the oral lobes, whilst the four intermediate buccal columns ("columnæ orales," *ac*) have a tendency to centripetal growth, project inwardly, and end below in the archings of the oral margin.

§ 111. Oral opening ("actinostoma, apertura oris, osculum," *aa*). In all Medusæ, the mouth is originally a simple, usually quadrate or cruciform opening at the lower end of the buccal stomach. Its margin, however, rarely continues perfectly simple, different organs being commonly developed from it, of which the four perradial oral lobes and the oral arms, which have arisen from their prolongation, are by far the most usual and the most important (§ 113). The terminal oral opening itself in the Medusæ usually shows the same characteristic cross figure as the transverse section of the œsophagus, the typical oral cross ("stomostaurus"), with four limbs projecting perradially and four intermediate angles projecting interradially (Pl. I. figs. 2, 4; Pl. XV. figs. 5, 6, &c.). The perfectly constant position of this oral cross is very important for the orientation of the transverse axes. The free oral margin or the margins of the oral arms are usually strongly armed with thread cells, which are often placed in special regularly distributed groups (Pl. I. fig. 4). As the gelatinous supporting plate below these groups of thread cells is arched conically or hemispheroidally, oral urticating papillæ or urticating knobs are formed (oral papillæ, "papillæ orales," *e.g.*, in *Pelagia*). If these grow in length, they become developed into the tentacle-like, cylindrical movable filaments, which serve, like the true (marginal) tentacles, both for feeling and for seizing upon prey. The structure of these oral tentacles or oral fingers ("digitella") completely resembles that of the inner "gastral tentacles," or gastral tentacles (§ 107) with which they were formerly often confounded ("oral filaments"). But the epithelium, which covers the solid gelatinous axis of the two analogous organs, belongs to the endoderm in the gastral filaments and to the ectoderm in the oral digitella. In many Semostomæ (*e.g.* *Aurelia*) and in all Rhizostomæ, a large number of digitella beset the margins of the oral arms. The oral styles ("stomostyli") are apparently similar, but essentially different organisms. They are developed principally in the Anthomedusæ, where they characterise the families of the Margelidæ and Dendronemidæ (System, p. 70, taf. v.–vii.). In structure they completely resemble the solid marginal tentacles, and consist of a cylindrical axis, formed of a single row of endodermal chordal cells (Pl. I. fig. 5, *d*); these are separated by a firm, elastic supporting plate (*z*), from a thin muscular plate (*m*), whose longitudinal fibres are connected with the ectodermal epithelium (*q*); the free distal end bears a spheroidal urticating knob (*m*). There are originally only four simple oral styles present at the four perradial oral angles (*Cytæis*, *Lizusa*, System, taf. v.–vii.). The œsophagus is sometimes prolonged secondarily into a long pendant proboscis, so that the oral styles, which were originally terminal, are found at its base (*Thamnostylus*, Pl. I. fig. 1; *Limnorea*, *Nemoposis*, System, pp. 86, 92, taf. v.).

§ 112. Buccal pouches and oral columns ("bursæ buccales" et "columnæ orales"). In some Medusæ of both sections, the thin, extensible walls of the œsophagus are extended into large evaginations, which project centifrugally to the outside (into the umbrella cavity), and may be compared from their form and function to the buccal pouches of many mammalia (*bb*). We term the thicker parts of the oral wall, which project inwardly centripetally between them, the oral columns (*ac*). The buccal pouches are most strongly developed among the Acraspedæ in the Peromedusæ, where they form four powerful perradial archings outward of the large buccal stomach and appear inflated hemispheroidally or even spheroidally (as in *Periphylla*, Pls. XVIII.–XXV., *bb*). Each single inflated buccal pouch is sometimes more voluminous here than the whole central stomach. The four thick intermediate, interradial oral columns (*ac*) project internally with their axial surfaces extended like wings, in such a way, that the adradial side spaces of the four buccal pouches form special niches or wing pouches behind these oral wings (*ad*, comp. also System, p. 405, taf. xxiv. fig. 14). Among the Craspedotæ the buccal pouches are most strongly developed in the Trachomedusæ, whose œsophagus is often highly extensible. *Pectis* (Pl. V. figs. 2–5; Pl. VI. fig. 11) has sixteen subradial buccal pouches, which are developed in pairs from four perradial and four interradial evaginations of the œsophagus, and are separated by eight adradial subumbral oral funnels (Pl. V. fig. 5, *io*). Other Trachomedusæ have eight adradial buccal pouches (formed by the division of four perradial).

§ 113. Oral lobes and oral arms ("lobi orales," *al*; "brachia oralia," *ab*). In the majority of Medusæ the oral margin is not simple, but its four perradial corners are prolonged into four leaf-shaped oral lobes or oral arms, between which four interradial oral sinus or oral incisions ("sinus orales") project internally. The four oral lobes have usually the shape of a thin oral leaf, whose delicate margins are folded more or less, often very daintily, whilst a strong midrib projects in the middle (as distal end of the perradial oral corner). The supporting plate of this midrib is often thickened gelatinously, shaped like a groove, concave outside and convex inside. The axial inner side of the oral lobes is always covered by endoderm, its abaxial outer side by ectoderm (comp. in the System, 1879, the oral lobes of the Anthomedusæ, taf. iii., iv.; of the Leptomedusæ, taf. viii., x., xi., xiii.; of the Trachomedusæ, taf. xvi., xviii.; of the Narcomedusæ, taf. xix., xx.; of the Stauromedusæ, taf. xxi., xxii.; of the Peromedusæ, taf. xxiii., xxiv.; of the Cubomedusæ, taf. xix., xx.; of the Discomedusæ, taf. xxvii., xxx., xxxii., xxxiii.). The oral lobes are termed "oral arms," if the four perradial oral lobes are very large, and the intermediate oral sinus so deep that they divide the œsophagus almost, or completely into four parts. These oral arms attain an extraordinary development in the order of the Discomedusæ, in the sub-order of the Semostomæ, namely, in the "pennon-mouthed" Pelagidæ (System, taf. xxxi.), and Cyaneidæ (System, taf. xxx.). In most Cyaneidæ they resemble delicate curtains with numerous folds, which are frequently larger than the whole umbrella, and are therefore termed "oral curtains" (Pls. XXX., XXXI.).

§ 114. Quadripartite mouth of the Rhizostomæ. The third and last sub-order of the

Discomedusæ, the rich group of the Rhizostomæ (System, 1879, pp. 464, 560, taf. xxxiv.–xl.) is distinguished by an extremely peculiar development of the mouth, unique of its kind in the whole animal kingdom. This has arisen phylogenetically from the second sub-order, the Semostomæ (*loc. cit.*, taf. xxx.–xxxiii.), as the latter is derived from the Cannostomæ, *loc. cit.*, taf. xxvii.–xxix.). This plainly points out the ontogeny of the Rhizostomæ, which are Cannostomæ in their earliest stage, then become Semostomæ, and are finally transformed into Rhizostomæ. The simple quadrangular œsophagus of the Cannostomæ first shows four delicate, frilled oral lobes at the oral margin (Ephyridæ, System, taf. xxvii.; Flosculidæ, taf. xxvii.). As these increase considerably in size, and the intermediate four interradial oral sinuses take the form of deep incisions, they are transformed into four strong, perradial oral arms, which are developed in most Ulmaridæ into long oral pennons (System, taf. xxxi.–xxxiii.). In one Ulmarid (*Aurosa*, System, taf. xxxiii. figs. 7, 8), the four perradial oral arms are bifurcated at the distal end into two lobes. In this way, the eight adradial oral arms are formed, which are present in all Rhizostomæ, and which are only connected in pairs at their bases; where they are usually connected with four strong perradial oral pillars (*ap*). Whilst the thin leaf-like

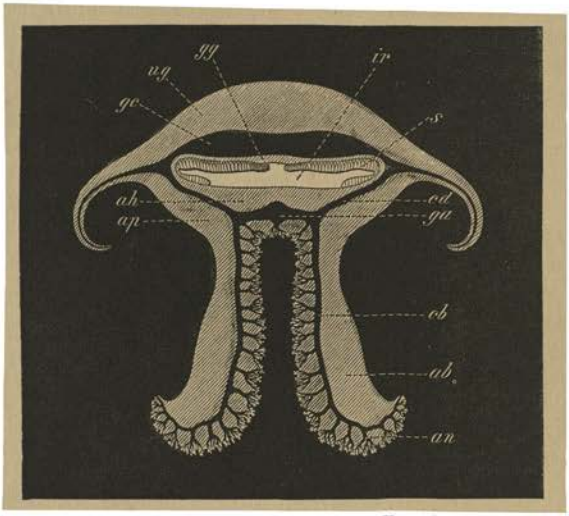


Fig. K. *Cannorhiza connexa* (Discomedusæ, Versuridæ).

Adradial section. (*ug*) Gelatinous umbrella. (*gc*) Central stomach. (*gg*) Bottom of the central stomach (gastrogenital membrane with the genitalia, *s*). (*ir*) Subgenital porticus. (*ah*) Brachiferous plate. (*ap*) Arm Pillars. (*cd*) Pillar canals. (*ga*) Buccal stomach. (*ab*) Oral arms (adradial). (*cb*) Branchial canals. (*am*) Funnel frills (sucking mouths).

margin of the arms are strongly frilled, their thick midrib is deepened into a groove on the concave endodermal side (oral grooves, "sulci orales," *az*). The separate folds of the strongly frilled oral margins are laid against one another in such a way that the opposite and contiguous endodermal surfaces of the groove-shaped folds become fused at the points of junction, and transformed into short canals. They open freely on the outside by a funnel at the distal end, towards the inside into the perradial oral groove by a fissure. By fusion of its margins, this oral groove is transformed into a canal (brachial canal). Finally, as the central oral opening becomes fused between the bases of the four oral pillars, and closed by a cruciform "oral suture" (Pl. XXXII. fig. K), they are physiologically represented by the numerous "frill funnels" (funnel mouths or sucking mouths). This polystome of the Rhizostomæ, therefore, finally rests upon the division into many parts of the originally simple mouth; the central part becomes fused whilst it is replaced by numerous peripheric oral funnels. The fusion of the oral frills is therefore dependent upon endodermal concrescence or the formation of cathamma, as in the septa between the subumbral radial divisions of the coronal intestine. The endodermal cathammal plate (§ 101) is persistent in both cases. The funnel frills of the Rhizostomæ, whose freer oral margin is usually thickly beset with countless digitellæ, may produce varied appendages. Thus, urticating clubs are formed by annular fusion ("concrescentia annularis"), (*e.g.*, *Cassiopea*, *Cotylorhiza*, System, taf. xxxvii.), whilst the urticating scourges are formed by fissure-shaped fusion ("concrescentia longitudinales"), ("*e.g.*, *Cephea*, *Lychnorhiza*, System, taf. xxxiv.).

§ 115. Palate or palatine opening ("palatum, porta palatina," *gp*). This is the name applied to the circular constriction by means of which the œsophagus in most Medusæ is more or less clearly separated from the central stomach. In many cases it is insignificant or almost obliterated, whilst in others it appears distinctly as a slender neck (comp. in the System, for example, the Anthomedusæ, taf. iii., iv., vii.; the Leptomedusæ, taf. x., xii., xiii.; the Trachomedusæ, taf. xvi., xviii.; the Narcomedusæ, taf. xix., xx.; the Stauromedusæ, taf. xxi., xxii.; the Peromedusæ, taf. xxiii., xxiv.; the Cubomedusæ, taf. xxv., xxvi.; the Discomedusæ, taf. xxvii., xxviii., xxx., xxxi., &c.). The palatine opening is usually the narrowest part of the principal intestine, and in many cases appears capable of closing voluntarily, so as to debar the water from passing in from the buccal to the central stomach. The form of the palatine opening is usually distinctly cruciform; the four perradial limbs of this "palatine cross" forming the upper terminal portion of the "oral cross," project centrifugally towards the outside, their concave abaxial ends being often depressed into a groove, (palatine groves "sulci palatini,") *gs*, Pl. XX. fig. 11). They are sometimes supported by a strong, node-like thickening of the fulcral lamella (palatine nodes, "nodi palatini," *gk*, Pl. XX. figs. 9, 10). The four interradial palatine lips ("labia palatina" *gl*), which project centripetally inwards, lie between the palatine nodes (System, taf. x. fig. 6; taf. xxiv. fig. 14; taf. xxviii. fig. 5, taf. xxxi. fig. 3); the gelatinous fulcral plate of the latter is often as strongly thickened as that of the former, and frequently becomes as hard as cartilage, especially in the larger Acraspedæ. In many Cyaneidæ it forms a thick palatine ring as hard as cartilage ("annulus palatinus," Pl. XXX. figs. 30, 31, *aw*). The Cubomedusæ *Chirodropus* is distinguished by the development of its palatine lips, into four interradial palatine valves ("valvulæ palatinæ," System, p. 429, taf. xxvi. figs. 3, 4, *k*); they resemble the semilunar valves of the human heart in form, have their concave side turned to the central stomach, which they can close completely and so prevent any communication with the œsophagus.

§ 116. Central stomach or central cavity ("gaster centralis, cavitas centralis, *gc*). The second and middle chamber of the three chambers of the axial principal stomach, the central stomach, is homologous in the free-swimming Medusa, with the central calyx cavity, or the true stomach of the sessile polyps. It is separated from the buccal stomach above by the palatine opening ("palatum"), from the basal stomach, below by the pyloric opening ("pylorus"). In the side walls of the central stomach there are four perradial (rarely more) openings ("ostia gastralia") by which it communicates with the surrounding pouches or canals of the coronal intestine. The general form and relative size of the central stomach varies most remarkably, and is often difficult to define. It usually forms the widest and broadest of the three chambers of the principal intestine, whilst the buccal stomach is the longest. The central stomach is sometimes entirely enclosed in the gelatinous substance of the umbrella, sometimes not; in the former instance its horizontal axis is usually considerably larger than its vertical, in the latter instance it is usually the reverse. We can therefore generally distinguish two principal forms of the central stomach, which are, however, connected by numerous intermediate forms and cannot be sharply defined,—the high obelisk stomach, and the flat lens stomach. The high obelisk stomach ("gaster centralis obeliscus") has usually the form of an obelisk or a truncated quadrate pyramid (Pls. XV.–XXIV.); the palatum forms its lower base, the pylorus its upper base, the four perradial gastral ostia correspond to the four angles of the obelisk, the four interradial side walls of the central stomach or the obelisk plates ("tabulæ obelisci," *gz*) to the four sides. The vertical axis of the obelisk stomach is usually larger than the horizontal diameter. It usually hangs freely in the umbrella cavity and is often fastened to a shorter or longer "gastral peduncle" ("pedunculus gastralis," *us*, see above); this is the case in the majority of the Anthomedusæ (System, taf. iii., iv., vii.), of the Leptomedusæ (System, taf. xi.–xv.), and of the Trachomedusæ (System, taf. xvi.–xviii.), also among the Acraspedæ in most Tesseroniæ, in the Stauromedusæ as well as the Peromedusæ and Cubomedusæ (System, taf. xxi.–xxvi.). In many cases four perradial mesenteric folds or mesogonia serve to fasten the freely hanging obelisk stomach to the subumbrella; the Pectyllidæ are distinguished by eight such mesogonia (four perradial and four interradial) (Pls. III.–VIII.). The second principal form of the central stomach, the flat lens stomach ("gaster centralis lenticula") only predominates in two orders, in the Narcomedusæ among the Craspedotæ (System, taf. xix., xx.), and in the Discomedusæ among the Acraspedæ (System, taf. xxvii.-xl.). The horizontal axis of the central stomach is usually much larger than the vertical, and the lenticular flat central stomach does not project at all, or only slightly into the subumbral umbrella cavity; its peripheric margin is cut away like a lens. As the basal stomach, and, consequently, the pylorus, are wanting, the flat upper wall or cover of the stomach is formed immediately by the discoid gelatinous substance of the umbrella; the lower wall or bottom of the stomach is supported by a thick gelatinous plate of the subumbrella, and communicates in the middle through the palatum with the œsophagus (Pls. XXVI.-XXXI.).

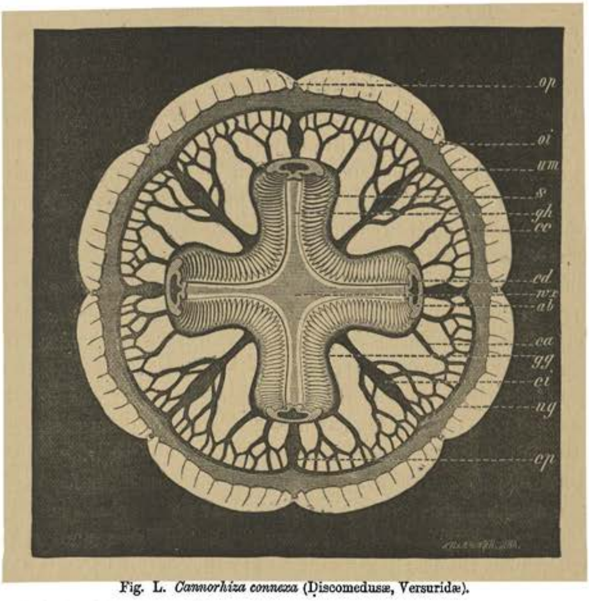


Fig. L. *Cannorhiza connexa* (Discomedusæ, Versuridæ).

Subumbral view of the umbrella. The arm disk with the eight oral arms is removed, as the four perradial arm pillars (*ab*), which connect the umbrella disk and the arm disk, are cut through. (*oi*) Interradial sense clubs. (*um*) Umbrella margin (turned over inwards). (*s*) Genitalia. *wx*) Gelatinous cross of the gastrogenital membrane. (*gg*), (*gh*) Peripheric limbs of the gelatinous cross. (*ug*) Peripheric umbrella corona. (*cc*) Coronal canal. (*cd*) Pillar canals. (*ca*) Adradial canals. (*ci*) Interradial canals. (*cp*) Perradial canals.

§ **117.** Cruciate chambers and cruciate columns ("cameræ cruciatæ" et "columnæ cruciatæ"). In many Medusæ of different groups the quadrate central stomach assumes a more or less distinct cruciate form, as four perradial archings outwards alternate with four interradial archings inwards in the same fashion as in the oral cross and the palatine cross (Pl. XXXII. figs. 3, 4). We therefore term the four perradial limbs of the central gastral cross, the cruciate chambers, and the four interradial gelatinous pieces of the umbrella, projecting centripetally between them, the cruciate columns. The latter correspond morphologically to the interradial centre of the obelisk plates, and at the same time to the central section of the tæniola. The cruciate form of the central stomach is prominently developed in many Anthomedusæ (System, taf. iv., figs. 7, 9), the Leptomedusa (System, taf. viii. fig. 6), Stauromedusæ (System, taf. xxi., xxii.), and Discomedusæ (System, taf. xxviii., xxix,, &c.). The cruciate chambers are most strongly developed in the sub-order of the Rhizostomæ, in which they are often considerably larger than the central cruciate cavity (System, taf. xxxvii.–xl.). The cruciate chambers attain special importance, when the reproductive glands are mostly or entirely developed in them; in such cases they are sometimes developed into independent genital pouches as in many Anthomedusæ and Discomedusæ.

§ 118. Gastral fissures ("ostia gastralia," *go*). The communication between the central principal intestine and the peripheric coronal intestine in all Medusæ takes place exclusively by means of the radial "gastral fissures," which are usually limited to the side-wall of the central stomach. The number of these gastral ostia corresponds to that of the chambers of the coronal intestine which open into the central stomach, and therefore amounts to four in the majority of the Medusæ. Four secondary interradial gastral ostia are, however, often added to the four primary perradial, and sometimes also a larger and usually variable number of succursal gastral fissures. The latter vary extremely in form and size. In general, the gastral ostia naturally form large and wide fissures in those Medusæ, whose coronal intestine consists of broad pouches and narrow septa, therefore in most Acraspedæ, and, for example, in the Tesseroniæ, the Cannostomæ, and in the Typhlocannæ among the Semostomæ (Pls. XV.–XXXI.). On the other hand the gastral ostia form small and narrow holes in those Medusæ, whose coronal intestine is composed of narrow canals with broad septa; therefore in most Craspedotæ, both in the Cyclocannæ and Rhizostomæ, among the Discomedusæ (Pls. I.–VIII., XXXII.). According to their position, the gastral openings sometimes lie vertically, sometimes obliquely, sometimes horizontally. Most Tesseroniæ are distinguished by very large, wide gastral ostia; they lie vertically or subvertically in most Peromedusæ, and in one part of the Stauromedusæ (Pls. XVI.–XXV.), whilst they are horizontal or sub-horizontal in most Cubomedusæ (Pl. XXVI.), and in another part of the Stauromedusæ; in all cases the margins of the gastral ostia are entirely or for the most part edged with phacelli (Pl. XVII. fig. 21). Sometimes, namely in the Cubomedusæ, there are valves by which the gastral ostia can be closed. The small Narcomedusæ group of the Solmonetidæ, in which the entire coronal intestine is obliterated, is distinguished by the entire want of the gastral ostia (*Solmaris* and *Solmoneta*, System, taf. xix. figs. 10–12; taf. xx. figs. 7–10). In consequence of this retrograde formation in *Solmaris*, the whole gastrovascular system is reduced to a simple, lenticular, central stomach.

§ 119. Pylorus or gastral opening (" porta pylorica, " *gy*). In most Medusæ in which the basal stomach is developed, the latter appears more or less sharply defined from the central stomach by a circular constriction. We term this the gastral opening or pylorus; it comports itself above in the same way as the palatine opening does above, but is wanting, of course, in all Medusæ in which the basal stomach has undergone retrograde formation. In the Anthomedusæ, the only Craspedotæ which have a basal stomach or apical canal, the pyloric opening is a simple, circular stricture, and only of special interest in the Cladonemidæ, as it perhaps corresponds to the " funnel opening " which separates the ectodermal " œsophageal stomach " from the endodermal " funnel cavity " in the Ctenophoræ (*Ctenaria*, System, p. 107, taf. vii.). The pylorus, like the basal stomach, is usually wanting among the Acraspedæ, in the Discomedusæ or Ephyroniæ, whilst it is usually very pronounced in the Tesseroniæ. In the Stauromedusæ the plyoric stricture is sometimes obliterated, sometimes deeply inserted (taf. xv. figs. 2, 3, *AB*). In the Peromedusæ it is sharply defined by the proximal margin of the coronal sinus (Pl. XXI. figs. 12, 13, *CD*). Special " pyloric valves " (" valvulæ pyloricæ ") which project inwardly from the four interradial angles of the quadrate stricture and from the bottom of the four small pyloric pouches (" bursæ pyloricæ, " *by*), are often developed in the Cubomedusæ and in the Cannostomæ.

§ 120. Basal stomach or basal tube (" gaster basalis," vel " tubus cupolaris," also termed " peduncle canal, peduncle tube, apical canal, or cone canal," *gb*). The basal stomach is the third and uppermost of the three principal chambers of the central principal intestine; it is separated by the pylorus from the central stomach, and corresponds to the peduncle tube or peduncle canal of the stalked polyps. It is lost in the majority of Medusæ, and only preserved by inheritance in a few groups. We only find it among the Craspedotæ in part of the Anthomedusæ, where it appears as a simple, narrow canal, which traverses the apical process of the umbrella cone, ending cæcally in the point of the latter; the stomach of the germinating Anthomedusæ was originally connected by this peduncle canal with the stomach of the nursing Tubularia polyp (comp. System, p. 5, taf. i., ii., iv., vii.); in many Cladonemidæ it is inlarged into a spacious apical cavity (" cavitas cupolaris "), which is sometimes occupied by the young brood (*Pteronema*, *Eleutheria*). The enlarged pyriform apical cavity of the Cladonemidæ is of great interest as it probably corresponds to the funnel cavity of the Ctenophoræ (System, pp. 99, 107, taf. vii., *Ctenaria*). Among the Acraspedæ the basal stomach is usually entirely wanting in the depressed Discomedusæ or Ephyroniæ, whilst it is constant and usually highly developed in the three other orders, the highly arched Tesseroniæ, It appears in the Stauromedusæ (in the Tesseridæ, Pl. XV., and Lucernaridæ, Pl. XVI., XVII.) as a shorter or longer quadrilateral canal which traverses the apical process or peduncle of the umbrella, and terminates cæcally at its aboral end. The four interradial tæniola (*ft*) divide the peduncle canal into four perradial semicanals (peduncular grooves or niches of the basal stomach, "semicanales basales," *gn.*, Pl. XVI. fig. 13). In some Lucernaridæ these become four separate peduncular canals ("canales basales"), as the four interradial tæniola met in the axis of the stomach where they are fused into a central column ("columella"). In the Peromedusæ, the basal stomach is always highly developed, is sharply defined from the central stomach by the pyloric ring (which corresponds to the upper margin of the "coronal sinus"), and is divided by the projecting tæniola into four niches or semicanals. The division into four of the conical basal stomach is more strikingly defined if the four tæniola are transformed into hollow cones by the subumbral funnel cavities, which in *Periphylla* penetrate to the point of the cone (Pl. XXI. figs. 12–18, *ib.*). In the Cubomedusæ the basal stomach is sometimes fused with the central stomach, sometimes separated from it by a pyloric stricture, in which case it forms a very flat, low, quadrate cavity; its four interradial angles are sometimes extended into four low, triangular pyloric pouches ("bursæ pyloricæ, *by*), which are separated from the central stomach by four projecting pyloric valves (System, p. 430).

§ 121. The two principal forms of the coronal intestine ("gaster coronaris," "perogaster"). Under the term "coronal intestine," we include the whole peripheric gastrovascular system of the Medusæ, which surrounds the central principal intestine like a garland, and only communicates with it by the gastral openings. Although it has essentially the same formation in both sections of the class, we may assume that it has been developed independently in both sections. The fusion of the two walls of the peripheric gastral space, by which the radial chambers of the coronal intestine originate, shows an essential difference in the two sections. In the Craspedotæ, which are descended from Hydropolyps (without tæniola), the concave inner surface of the not-umbrella or dorsal umbrella, is fused almost throughout its entire extent with the convex outer surface of the cœlumbrella or ventral umbrella, in such way that the cathamma originally represent four broad plates, between which only four narrow radial canals remain over; these are connected in a supplementary manner by a secondary coronal canal. In the Acraspedæ, on the other hand, which are descended from the Scyphopolyps (with the four characteristic tæniola), these gastral ridges are the starting-point of the concresence; at four interradial points the dorsal point of the four tæniola (on the notumbrella) is fused with their ventral part (on the cœlumbrella) in such a way that the cathamma originally represent four small nodes or narrow ridges, between which the four broad radial pouches remain free; these communicate at the peripheric umbrella margin below the four nodes, by a primary coronal canal, the distal remains of the simple gastral space. Although these two essentially different principal forms of the coronal intestine in the two sections probably express a comprehensive primary difference in its conformation, modifications of it are present in both sections, which make it possible to confound the formations derived from them. The Narcomedusæ, especially, approach the Acraspedæ strikingly, the Cubomedusæ the Craspedotæ. In spite of this, the two groups are genetically entirely different, and it is therefore quite to the purpose to consider the two principal forms of the coronal intestine separately; we designate the former, the vascular corona, the latter the pouch corona.

§. 122. Vascular corona of the Craspedotæ ("corona canalium"). In the majority of the Craspedotæ one and the same form of the coronal intestine is maintained, the vascular corona, which must be regarded as the typical and original form for this section.

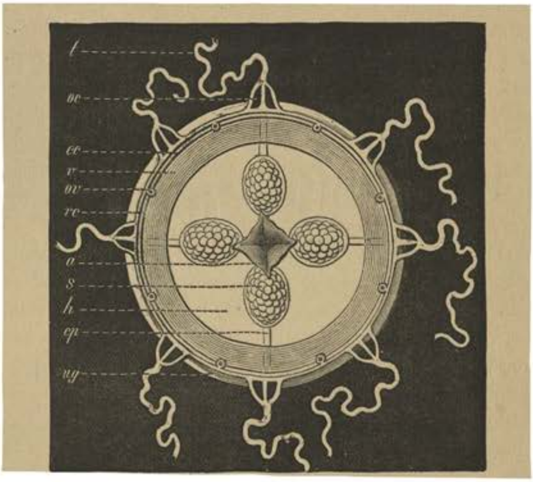


Fig. M. *Eucope campanulata* (Leptomedusæ, Eucopidæ).

Subumbral aspect. (*a*) Quadrate oral opening. (*s*) Ovaries. (*cp*) Perradial canals. (*cc*) Coronal canals (*v*) Velum. (*ov*) Velar marginal vesicels, (adradial). (*h*) Umbrella cavity. (*rc*) nerve ring. (*oc*) Ocelli at the swollen bases of the tentacles. (*ug*) Gelatinous substance of the umbrella. (*t*) Tentacles.

It is composed of four narrow, perradial canals (fig. M *cp*) which run out from the four angles of the central stomach, and pass through the subumbrella to the umbrella margin, where they are united by a coronal canal (*cc*) (comp. Pls. I. II.) The typical quadrilocular vascular corona of their Hydropolyps has arisen from the simple gastral space of their predecessors the Hydropolyps, by their two walls (calyx wall and peristom wall) being laid together and fused in such a way that only four narrow radial canals remain open between them. The broad concrescentic surfaces between the four perradial canals still contain in the developed Craspedotæ the important (originally double) layer of endoderm cells which authenticate their origin (cathammal plate, § 101). The marginal coronal canal (*cc*), which connects the four radial canals at the umbrella margin, does not appear to be the marginal part of the originally simple gastral space (of the Hydropolyps) which remains open, but to have arisen from the distal ends of the radial canals which remain open, being connected by marginal processes (hence the secondary coronal canal). This typical primitive form of the coronal intestine of the Craspedotæ is subject to varied modifications, of which some (Narcomedusæ) are so like the pouch corona of the Acraspedæ that they may be confounded with it ("convergent selection").

§ 123. Radial canals ("canales radiales," *cr*). In the majority of Craspedotæ we only find four perradial canals, which open into the coronal canal at the insertion of the four primary tentacles. They are usually very narrow and cylindrical, more rarely flattened like a ribbon (in some Tiaridæ, Geryonidæ, Narcomedusæ). There are rarely six canals instead of four (in part of the Cannotidæ and Geryonidæ, System, taf. ix. figs. 6–9; taf. xviii. figs. 7, 8). In some families eight canals are constant, as four interradial secondary canals are developed supplementarily in the middle between the four perradial (Pls. III.–VIII.; Melicertidæ, Octocannidæ, Trachynemidæ, Aglauridæ, System, taf. viii., xvi., xvii.). On the other hand we rarely find eight adradial canals, which have arisen from basal bifurcation of the four perradial (*Ctenaria*, *Cladonema*, *Dendronema*, System, taf. vii.). In the Æquoridæ the number of the radial canals rises from 8 to from

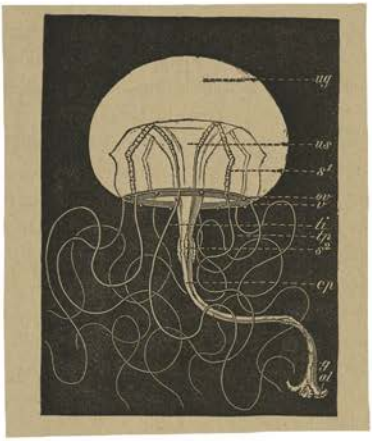


Fig. N. *Octorchis germanica* (Leptomedusæ, Eucopidæ).

Profile view. (*ug*) Gelatinous umbrella. (*us*) Solid gelatinous peduncle of the stomach. (*v*) Velum. (*ov*) Velar marginal vesicles. (*tp*) Perradial tentacles. (*ti*) Interradial tentacles. (*s'*) Distal testis (on the subumbrella). (*s²*) Proximal testis (on the œsophagus). (*cp*) Perradial canals. (*g*) Stomach. (*al*) Oral lobes.

50–60, sometimes to from 100–200 and more, and is at the same time very inconstant (System, taf. xiv., xv.). Their number is likewise variable and inconstant in the Narcomedusæ, where it never rises beyond 32 and usually amounts to between 11 and 20 (System, taf. xix., xx.). Whilst the radial canals of most Craspedotæ, are quite simple and unbranched, the three sub-families of the Cannotidæ, are distinguished by their being repeatedly ramified; the radial canals of the Polyorchidæ are beset with cæcal side branches, and consequently appear pinnated (*Ptychogena*, Pl. II.); in the Berencidæ both the simple or ramified side branches of the radial canal, and their direct process open into the coronal canal; in the Williadæ the radial canals are bifurcated as in the Cladonemidæ and Zygocannidæ; the bifurcations may also be repeatedly dichotomised (System, taf. ix.). In those Craspedotæ where a solid gelatinous gastral peduncle is developed in the centre of the subumbrella, each radial canal is divided into two sections, an ascending peduncle canal, and a descending subumbral canal; the peduncle canal leads from the bottom of the stomach at the oral end of the gastral peduncle to the base of the latter (in the bottom of the subumbrella); the subumbral canal from the last-named point to the coronal canal (fig. N).

§ 124. Coronal canal of the Craspedotæ (" canalis circularis," *cc*). In all Craspedotæ the radial canals are originally connected at the umbrella margin by a coronal canal (" canalis circularis "). Its ontogenesis shows that it does not arise from the primary gastral space remaining open at its peripheric margin, but by secondary anastomotic formation of the radial canals. Whilst the latter are formed by the two endodermal surfaces of the simple gastral space of the polyps becoming fused into four broad interradial cathammal plates, the connective coronal canals at the distal end of the open radial canals are formed by the separation of their two epithelial layers (dorsal and ventral endoderm) at the distal margin of the endodermal cathammal plates. The marginal coronal canal of the Craspedotæ, is therefore formed in the same way as the secondary coronal canal of the Cycloperiæ among the Discomedusæ, whilst the primary coronal canal (or better, " coronal sinus ") of the other Acraspedæ has quite a different formation (comp. § 126, 123). The tentacle canals, which pass into the hollow tentacles, run out in a distal direction from the simple coronal canal of the Craspedotæ. The " centripetal canals " which run out from the coronal canal towards the middle of the subumbrella, where they end cæcally (§ 135), are sometimes developed in a proximal direction.

§ 125. Festoon canal and radial pouches of the Narcomedusæ. The order of the Narcomedusæ is distinguished by a peculiar condition of formation of the coronal intestine, apparently completely different from that of the other Craspedotæ. Broad cæcal pouches apparently proceed from the central stomachs, which are not connected by a coronal canal, and resemble those of the Typhloperiæ among the Discomedusæ. More minute comparative investigation however shows that they cannot properly be compared with the latter, but that the typical fundamental form of the coronal intestine is the same here as in all other Craspedotæ, *i.e.*, four narrow perradial canals communicating by a coronal canal at the umbrella margin. This original formation only undergoes peculiar modifications, which appear to be influenced pre-eminently by the centripetal migration of the tentacles on to the exumbrella (comp. System, 1879, taf. xix., xx. pp. 302–306). Whilst in other Craspedotæ the tentacles usually retain their original position on the umbrella margin, in the Narcomedusæ they migrate from there up to the dorsal surface of the exumbrella, towards the apex, taking with them, from their original insertion, part of the umbrella margin, whose urticating ring is transformed into a centripetal umbrella clasp ("peronium"), (§ 68, Pls. IX.–XIV., *en*). The original marginal coronal canal, which lies on the inner side of the marginal urticating ring, follows the centripetal processes of the latter, which forms the peronium in the exumbrella and edges the two lateral margins of the peronium in the form of a double peronial canal ("canalis peronialis," *ck*, Pls. IX.–XIV.). The two parallel double canals (which are only separated by the peronium) open at the dorsal point of insertion of the tentacle, into the distal end of the true radial canal, which is expanded like a pouch (*Cunantha*, *Cunina*, System, taf. xix. figs. 1, 3). Whilst many Cunanthidæ (the Cunoctanthidæ) show this most simple condition and are therefore connected immediately with certain Trachomedusæ (Geryonidæ), in other Cunanthidæ (Cunoctonidæ) the distal part of each radial canal bifurcates into two cæcal pouches diverging distally, and these internemal lobe pouches therefore lie in pairs between each two peronia and peronial canals (*Cunarcha*, Pl. IX. figs. 2–4, *Cunoctona*, System, taf. xx. figs. 1–6). In the closely allied Æginidæ the simple proximal part of the widened radial canals has undergone retrograde formation or become merged into the periphery of the stomach, whilst the two lobe pouches which have arisen from their distal part are developed into independent internemal gastral pouches, opening immediately into the periphery of the stomach (*Æginura*, Pls. XIII., XIV.; *Ægina*, System, taf. xx.). The double peronial canals, which open into the stomach between each two pair of pouches, seem at first to be simple radial canals, connected by a simple coronal canal at the umbrella margin; this apparently simple coronal canal, however, really consists of four or eight separate marginal canals ("canales marginales," *cm*); these are completely separated by the distal ends of the peronia, and each marginal canal, along with the inverted halves of the two contiguous peronial double canals, forms a horseshoe-shaped arch canal. An arch canal opens by two separate ostia between each two peronia into the gastral cavity. The entire coronal canal, when formed as in the Æginidæ of four or eight separate canals, is called the festoon canal ("canalis festivus," *cf*, Pls. XIII., XIV.). The Peganthidæ (Pls. X.–XII.) present another modification. The radial canals are merged in the central stomach or have undergone retrograde formation, so that the festoon canal (or the modified coronal canal) opens immediately into the stomach and with twice the number of openings than the number of arches composing the festoon canal; each arch opens by two gastral ostia (*go*). In the family of the Solmaridæ the festoon canal is completely obliterated; the radial canals may also be completely obliterated here (Solmonetidæ), whilst in other Solmaridæ, the pernemal gastral pouches remain (Solmissidæ), sometimes the internemal gastral pouches (Solmundinæ, System, taf. xix. xx. p. 346).

§ 126. Pouch corona of the Acraspedæ (" corona bursarum "). In contrast to the canal corona of the Craspedotæ, an essentially different form must be regarded as the typical and original arrangement for the section of the Acraspedæ, *i.e.*, the pouch corona composed of four wide, perradial pouches, which begin at the circumference of the central stomach, and run in the subumbrella towards the umbrella margin where they are united by a coronal canal. This typical quadripartite pouch corona of the Scyphomedusæ, has been developed from the simple gastral space of their ancestors the Scyphopolyps by the four interradial tæniola of the latter being laid together and fused at four points (of equal height), or in four streaks, by their upper dorsal parts and lower ventral parts. In this way four small interradial nodes or narrow ridges are originated (Pl. XV. figs. 2, 3, *kn;* Pl. XVI. figs. 2, 3, *ks*), which form incomplete septa between four wide perradial pouches (*bp*). The small fused nodes or the four narrow fused ridges in the mature Acraspedæ still contain a double layer (or a layer become simple by fusion) of endoderm cells, which indicates this origin as a cathammal plate (§ 101, Pl. XXV. fig. 8). The marginal coronal canal which connects the four broad pouches at the umbrella margin below the four narrow septa, appears to be the marginal part of the originally simple gastral space of the Scyphopolyps, which has remained open (therefore a "primary coronal canal"). This typical primitive form of the coronal intestine of the Acraspedæ is subject to varied modifications, of which some (Flosculidæ) are so like the canal corona of the Craspedotæ that they may be confounded with it (" convergent selection ").

§ 127. Radial pouches (" bursæ radiales," *bs*). The constant number of four of the perradial pouches of the Acraspedæ is very remarkable when contrasted with the frequent variations of the number of four shown by the Craspedotæ. The four perradial pouches are orignally (phylogenetically) present, though they are often lost at an early stage. They correspond to the four flat gastral pouches of the Scyphostoma, which are constantly separated by four interradial tæniola. Frequent individual exceptions (especially individuals with six or eight radial pouches) are of no importance, as they do not transmit their peculiarity. The two sub-sections of the Acraspedæ, the Tesseroniæ and Ephyroniæ, are, however, in general strikingly distinguished, as in the Tesseroniæ (Pls. XV., XXVI.), the four primary radial pouches always remain very large, and with the coronal sinus belonging to them form the permanent principal component part of the coronal intestine, whilst in the Ephyroniæ (Pls. XXVII.-XXXII.) they have usually undergone retrograde formation or become merged by fusion into the central stomach; they appear, however, to be of no great importance, and to have retreated towards the peripheric pouch corona. The latter, which consists of at least eight, but usually of sixteen radial coronal pouches, always forms the principal component part of the coronal intestine in the Ephyroniæ, whilst in the Tesseroniæ it has retreated completely against the inner quadrilocular pouch corona. Important differences, are, however, connected with the further organisation of the two sub-sections. It is therefore practical to consider the radial pouches of the Tesseroniæ and Ephyroniæ separately.

§ 128. The four perradial pouches of the Tesseroniæ. In all the three orders of the Tesseroniæ, the Stauromedusæ, Peromedusæ, and Cubomedusæ, the four primary perradial pouches (*bp*) form, from their circumference and extent, by far the most important part of the coronal intestine, whilst, on the other hand, the marginal pouch corona has retired against its periphery (System, pp. 363–449, taf. xxi.–xxvi.). As in all Tesseroniæ, the umbrella is highly vaulted, and its fundamental form represents a high quadrate pyramid (usually truncated above), the four broad pouches occupy its four lateral surfaces, whilst the intermediate four interradial septa correspond to the four angles of the regular pyramid. Each quadrangular pouch communicates at the upper or proximal margin by a fissure-shaped gastral ostium (*go*) with the central stomach, at the lower or distal margin by two or more fissures with the marginal pouches; its two lateral margins are formed by the septa or cathamma, and their ideal (interradial) prolongations. All the four perradial pouches communicate below the four cathamma, by four interradial fissures, which taken together represent an ideal primary coronal canal, the coronal sinus ("sinus coronaris," § 134). Of the two flat, quadrangular walls of each perradial pouch, the outer (abaxial) is formed by the inner (concave) endodermal surface of the notumbrella, whilst the inner (axial) is formed by the endodermal surface of the cœlumbrella. Whilst all Tesseroniæ agree without exception in these essential general conditions of structure, many important modifications are found in detail which are referable on the one hand to the different extent of the cathamma, and on the other to the different position of the gastral ostia. In one portion of the Stauromedusæ, and in all Peromedusæ, the gastral ostia form narrow longitudinal fissures of the central stomach, standing more or less vertically, whilst in another portion of the Stauromedusæ, and in all Cubomedusæ, they form broad transverse fissures, standing more or less horizontally; the special anatomical relation of the proximal part of the pouch to the central stomach, therefore, differs considerably. As regards the four interradial septa of the four pouches or the four primary cathamma, in one portion of the Stauromedusæ (Tesseridæ), and in all Peromedusæ, they form small, but very firm nodes, as hard as cartilage ("nodi cathammales," Pl. XV. figs. 2–6, *kn*; Pls. XX.–XXIV., *kn*); whilst in the other portion of the Stauromedusæ (Lucernaridæ), and in all Cubomedusæ, they form long, narrow ridges ("limites cathammales," Pls. XVI., XVII., *ks*). The Peromedusæ are, moreover, distinguished from all other Tesseroniæ by the union of the four perradial pouches above the four septal nodes, into a powerful upper coronal sinus, which encircles the central stomach, and reaches with its upper (closed) margin up to the pyloric ring (Periphyllidæ, Pls. XX., XXI., *co″*; comp. § 134).

§ 129. The four perradial pouches of the Ephyroniæ. In the second and younger sub-section of the Acraspedæ, the Ephyroniæ, the coronal intestine strikes out a direction of formation which contrasts thoroughly with, and differs essentially from that presented by the first and older sub-section, the Tesseroniæ. Whilst the four primary radial pouches of the coronal intestine in the Tesseroniæ are always very large, and form its principal component part, in the Ephyroniæ they appear to be wanting, or only to exist as small rudiments: up till now they have been completely overlooked in the Ephyroniæ or Discomedusæ, and not taken into account by any author on Medusæ. The two deep-sea Cannostomæ, *Nauphanta* (Pls. XXVII., XXVIII.) and *Atolla* (Pl. XXIX.), are of great importance for comprehending their formation; from their size they show the primitive formation more clearly than the known small *Nausithoe*, in which the four septal nodes are certainly also present but are very small, and have hitherto been invariably overlooked. In all the Cannostomæ named (and probably in all Discomedusæ of this sub-order) four interradial septal nodes (*kn*, Pl. XXVII. fig. 3; Pl. XXVIII. figs. 14, 15; Pl. XXIX. figs. 3, 6) are found in the upper part of the coronal intestine. They correspond completely, in situation and significance, to those of the Tesseridæ (Pl. XV. figs. 2–6, *kn*), and the Periphyllidæ (Pls. XX.–XXIV., *kn*). In *Atolla* (Pl. XXIX.) these important four interradial cathammal nodes are triangular and strongly flattened, whilst in *Nauphanta* (Pls. XXVII., XXVIII.), and also in *Nausithoe*, they are very small, and have as yet been taken no notice of. In their transverse sections, however, they show distinctly the important cathammal plate or endodermal lamella (*rk*), the fused plate between the gelatinous body of the notumbrella and the supporting plate of the cœlumbrella (Pl. XXV. fig. 8, *dk*). The ventral wall of the cœlumbrella and the dorsal wall of the notumbrella are fused by means of these four interradial fused nodes; between these four perradial transverse fissures remain, which represent the four rudimentary, very much shortened radial pouches, and whose proximal margin is at the same time to be regarded as a "gastral ostium" (*go*). If we suppose these nodes prolonged interradially downwards in the form of narrow septal ridges, the underlying coronal canal or coronal sinus (*cs*) will be thereby divided into four broad, long, radial pouches, resembling those of the Lucernaridæ (Pls. XVI., XVII., *bp*). In the two other sub-orders of the Discomedusæ, the Semostomæ and Rhizostomæ, the four primary septal nodes, which were originally present, appear to have undergone retrograde formation, and become lost, whilst the Cannostomæ have kept them faithfully up to the present day; the Cannostomæ—which in many respects still resemble the Tesseroniæ—being the ancestral form of the Discomedusæ, from which the Semostomæ have been developed later (and the Rhizostomæ still later from the Semostomæ). In the Ephyrula larva of the latter, the four primary gastral filaments, probably indicate the spot formerly occupied by the predecessors of the septal nodes. The four cruciate pouches of the central stomach already described, may perhaps be considered as partly or wholly the remains of the original four radial pouches of the coronal intestine, and the centripetal septal ridges between them, as remains of the cathammal plates.

§ 130. The marginal pouches of the Tesseroniæ. It is only in the Tesseridæ, the first and oldest family of the Tesseroniæ, that the peripheric coronal intestine is formed exclusively of the four large perradial pouches and the marginal coronal canal or coronal sinus, which connects the latter below the four interradial septa (*Tesserantha*, Pl. XV. figs. 2–6; *Tessera*, System, Pl. XXI.). In all other Tesseroniæ, other pouches are found at the distal margin of the four perradial pouches, which are developed as peripheric archings outwards of the latter and compose the corona of marginal pouches. In the Lucernaridæ they are represented by four pair of arm pouches which pass into the eight adradial arms or marginal lobes, from whose distal end they send out a tentacle canal into each tentacle (Pls. XVI., XVII.). The Charybdeidæ, in which the eight adradial marginal pouches are separated alternately by the four interradial septa and the four perradial "frenula velarii" (Pl. XXVI.), comport themselves quite in the same way. In the Chirodropidæ the number of radial pouches is doubled, as each of the eight adradial marginal pouches is split up into two subradial lobe pouches (System, p. 446, taf. xxvi.). In most Cubomedusæ, moreover (with the exception of the lowest forms, the Procharagmidæ) numerous simple or branched velar canals run out from the distal margin of the lobe pouches, extend in the velarium (the broad marginal membrane connecting the marginal lobes) and end cæcally with anastomosis (Pl. XXVI. fig. 8, *cv*). The conditions differ somewhat in the Peromedusæ, as in the Pericolpidæ, first of all (System, taf. xxiii.) eight principal coronal pouches (four perradial and four interradial) run out from the distal margin of the coronal sinus. Their subumbral walls form the eight coronal plates of the coronal muscle. Each of the eight coronal pouches is split up into a medial principal canal, and two distal lobe canals. The medial canal passes into the tentacle in the four perradial coronal pouches, into the sense clubs in the four interradial; whilst, on the other hand, the two lobe canals of each coronal pouch (*bl*) provide for the halves of each two adjacent canals turned to each other, at whose distal end they communicate by a horseshoe-shaped canal (*bw*) with the opposite canals of the other halves (Pl. XXII. fig. 22; Pl. XXIII. fig. 29). The Periphyllidæ are only distinguished from the Pericolpidæ by having three tentacles with two intercalary subradial marginal lobes in the place of each simple perradial tentacle (Pls. XVIII.–XXV.). As the whole lobe canals of the Peromedusa are connected below by U-shaped horseshoe canals (*bn*) at the distal end of the marginal lobes, a waved connected festoon canal of peculiar formation is developed in all Peromedusæ at the outermost margin of the lobed umbrella (Pl. XX. figs. 8, 22).

§ 131. The marginal pouches of the Ephyroniæ. Whilst in the Tesseroniæ the marginal pouches always appear as merely subordinate appendages on the distal margin of the four perradial pouches (or of the large coronal sinus formed by junction of the latter), in the Ephyroniæ or Discomedusæ they form the principal component part of the coronal intestine. They differentiate here in a great variety of ways. The more the four primary perradial pouches in the Discomedusæ become subsidary, the more extensive are the numerous and voluminous marginal pouches which take their place; in spite of this, the latter must be regarded here as originally distal processes of the former. It is important to distinguish the original from the later formations among the manifold and protean differentiations undergone by the corona of marginal pouches in the different groups of Discomedusæ. We consider the simple eight principal radial pouches (four perradial and four interradial) which appear universally in the Ephyra larva of the Ephyroniæ, and then pass into the eight typical sense clubs or rhopalia (and which are therefore called sense pouches, ocular pouches, or rhopalar pouches ("bursæ rhopalares," *br*) as the primitive marginal pouches of this order. They correspond to the eight coronal pouches of the Pericolpidæ (among the Peromedusæ), of which four likewise lie perradially and four interradially, the former passing into the tentacles, the latter into the rhopalia (woodcut, fig. O, p. xcvi.). Eight adradial alternating tentacle pouches, which pass into the eight typical tentacles of this order (Pls. XXVII., XXVIII., *bf*), are, however, immediately added to these eight principal rhopalar pouches. The characteristic corona of marginal pouches in most Ephyroniæ, therefore consists of sixteen coronal pouches ("bursæ coronares," *bc*), of which the eight principal rhopalar pouches are, however, phylogenetically older than the eight adradial tentacle pouches. All the sixteen pouches are separated by sixteen narrow septa or fused streaks; these sixteen subradial cathammal ridges correspond to the sixteen subradial peronia of the Periphyllidæ. The sixteen coronal pouches of the Discomedusæ do not, however, communicate like those of the Periphyllidæ by a marginal festoon canal (below the distal ends of the cathammal ridges), but remain originally completely separate and end cæcally. Many Ephyridæ still show this original condition, as the eight large or principal pouches end cæcally in the eight sense clubs, the eight smaller adradial pouches at the bases of the eight tentacles. The varied peripheric pouch formations of the Discomedusæ may all be derived from this primary condition as secondary modifications and more recent developments.

§ 132. Typhloperiæ, or Ephyroniæ without annular canal. According to the preceding view, the peripheric pouch corona of the Discomedusæ consists originally in all Acraspedæ of this order (as in all their Ephyrula larvæ at the present time) of sixteen simple, cæcal coronal pouches, separated by sixteen narrow subradial cathammal ridges, and from which the eight principal pouches (four perradial, four interradial) pass into the rhopalia, and the eight adradial into the tentacles. As regards the further differentiation of this originally simple pouch corona, there are two different types in this order so rich in forms; the older, conservative type, we shall term for brevity, the Typhloperiæ, the young and more progressive type the Cycloperiæ; the latter is distinguished by the acquisition of a second circular canal, which is still wanting in the former. Of the

Discomedusæ, the group of the Typhloperiæ, or Ephyroniæ, without coronal canal, includes first all the Cannostomæ (Ephyridæ, Linergidæ) and, secondly, half of the Semostomæ (Pelagidæ, Cyaneidæ). In these the sixteen coronal pouches always continue completely isolated, whether they remain simple or become repeatedly branched. The tentacles remain simple and unbranched in the Ephyridæ (System, taf. xxvii., xxviii.) and Pelagidæ (System, taf. xxxi.) each coronal pouch is, however, usually bifurcated into two lobe pouches, which provide for the inverted halves of each two neighbouring canals; the two simple cæcal lobe canals of each lobe therefore belong to two different adjacent marginal lobes and remain completely separated by the (subradial) peronium. Consequently, there are usually thirty-two cæcal lobe pouches present, but this number may be increased considerably by later division and the formation of secondary lobes. The Lineragidæ (System, taf. xxix.) and Cyaneidæ (System, taf. xxx.), on the other hand, are distinguished by distal ramification of the lobe pouches. Each lobe pouch sends out numerous bifurcate or dendritic canals from their periphery; these comport themselves like the "dendritic velar canals" of the Cubomedusæ (Pl. XXVI.), never form anastomoses, and end everywhere with cæcal branches at the periphery of the lobes (Pls. XXX., XXXI.).

§ 133. Cycloperiæ, or Ephyroniæ with annular canal. Whilst in the Typhloperiæ, described above, the sixteen original coronal pouches and their distal ramifications remain entirely separate, the second half of the Discomedusæ is distinguished by the development of a connecting coronal canal between the coronal pouches. Of the three sub-orders of the Discomedusæ, the Cycloperiæ or Ephyroniæ, with coronal canal, includes, first the half of the Semostomæ (Flosculidæ, Ulmaridæ), and, secondly, the whole of the Rhizostomæ. It is clear from the ontogeny of the Cycloperiæ that they are derived phylogenetically from the Typhloperiæ, and that their characteristic annular canal ("canalis annularis," *ck*) has been developed secondarily, as a circular, peripheric anastomosis between the originally separate, cæcal coronal pouches. The Ephyrula larva of the Cycloperiæ is so like that of the Typhloperiæ that they may be confounded together, and is also furnished with sixteen simple, cæcal, coronal pouches. In the course of their metamorphosis, these pouches in the Cycloperiæ form lateral processes which grow towards those of the neighbouring coronal pouches with which they enter into open anastomosis. In this way the secondary annular canal of the Cycloperiæ ("canalis annularis") is formed; it is analogous to, (not homologous with) the secondary circular canal ("canalis circularis") of the Craspedotæ, but different from the coronal canal or primary ring-canal of the Acraspedæ ("canalis coronaris"). The latter lies at the proximal side of the coronal pouches (between them and the four septal nodes), whilst the former lies on the distal side of the coronal pouches. Another important peculiarity of the Cycloperiæ stands in direct correlation to the development of their annular canals; the sixteen broad coronal pouches of the Typhloperiæ are transformed in all Cycloperiæ into sixteen narrow coronal canals, as the sixteen narrow subradial septal ridges between the pouches

(" limites cathammales ") are extended into sixteen broad septal plates (" tabulæ cathammales "). This originates a special form of the coronal intestine, which resembles the common form of the Craspedotæ so strongly that the two may be confounded, but which has arisen quite independently, and also differs essentially in its relation to the principal intestine. Moreover, the narrow " radial canals " of the Craspedotæ spring immediately from the central stomach, whilst the similar " coronal canals " of the Cycloperiæ spring originally from the distal margin of a coronal sinus, lying at the distal side of four cathammal nodes. Otherwise, both the further differentiation of the radial canals and their circular canals and their relation to the adjacent orders of the umbrella margin show the greatest similarity in both sections. The oldest family among the Cycloperiæ, the Flosculidæ (System, taf. xxxii.) show simple radial canals which are not branched inside the annular canal (as in the majority of the Craspedotæ). All the remaining Cycloperiæ (the Ulmaridæ and all Rhizostomæ) have branched radial canals, which branch inside the annular canal (as in the Cannotidæ among the Craspedotæ). In both cases peripheric canals of the annular canal run from it, outside it, into the tentacles, rhopalia, marginal lobes, &c. (§ 135).

§ 134. Coronal sinus of the Acraspedæ (" sinus coronaris, canalis coronaris "). The coronal sinus of the Acraspedæ (*cs*) already mentioned forms a very important arrangement, which has hitherto never been properly taken into account. It must not be confounded with the annular canal described above, but must be considered as an original and typical peculiarity of this section. Originally, it is a perfectly simple, cylindrical or flattened ring in the coronal part of the subumbrella, and is formed by the entire peripheric section of the coronal intestine, lying outside the distal margin of the four interradial cathammal nodes (*kn*) or ridges (*ks*), as in *Tesserantha* (Pl. XV. figs. 2–6, *cs*) and in *Tessera* (System, taf. xxi., *cs*), the closely allied ancestral form of all Acraspedæ. Although its ontogeny is still unknown, we may assume with certainty as regards its phylogeny, that it does not represent a secondary marginal communication of the four broad perradial pouches, but rather the marginal portions of the originally simple Scyphostoma stomach which has remained open, and lies outside the four interradial cathamma (*k*). As the latter are originally merely small fused nodes (as in the Tesseridæ and Peromedusæ), the intermediate perradial pouches at first merely form narrow horizontal fissures. As soon, however, as the nodes become elongated concrescentic ridges (as in the Lucernaridæ and Cubomedusæ) the insignificant horizontal fissures extend simultaneously into pouches of considerable size, at the cost of the broad coronal sinus, which is for the most part absorbed into them. The broad coronal sinus is thus reduced into a narrow coronal canal which keeps up the communication between the four large perradial pouches below the distal margin of their septal ridges (Pl. XVI. figs. 2, 3, 12, *cc*; Pl. XXVI.). The coronal sinus is most widely extended, and at the same time undergoes a very striking modification in the Peromedusæ, probably in direct correlation with the powerful extension of the four subumbral funnel cavities (*ci*) which here grow centripetally up as far as the pylorus (*gy*). The coronal sinus extends correspondingly upwards to the pylorus, and is divided into an upper and a lower part. The upper coronal sinus (fig. O, *cs′*) lies above the four small interradial septal nodes (*kn*), and may probably be really considered as a peripheric section of the central stomach (*gc*), whilst the lower coronal sinus (fig. O, *cs*) lies below the septal nodes and probably alone corresponds to the true primary coronal canal of the other Tesseroniæ. If this view be correct, the true gastral ostia (and at the same time the four perradial pouches) are represented by the horizontal cleft spaces between the four nodes, whilst the vertical fissures in the wall of the central stomach, which we have described as gastral ostia (fig. *O*, *go*) must be regarded as four cruciate pouches of the central stomach. It is possible, however, that the upper coronal sinus (*cs′*) has arisen from the secondary confluence of the four large

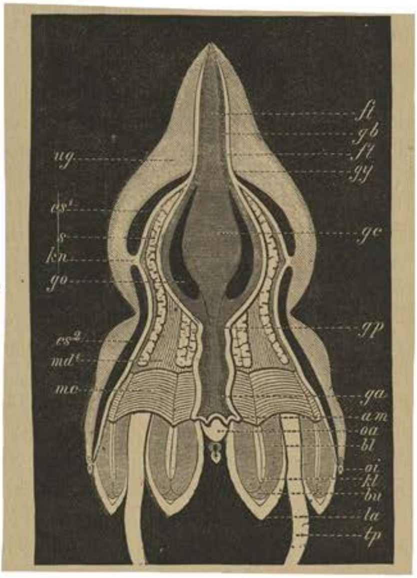


Fig. O. *Pericopla quadrigata* (Peromedusæ, Pericolpa).

Interradial section. (*ug*) Gelatinous umbrella. (*cs*) Coronal sinus (*cs′*) proximal part, (cs^2) distal part, (*s*) Genitalia. (*kn*) Cathammal nodes. (*go*) Gastral openings. (*md*) Deltoid muscles. (*mc*) Coronal muscle. (*ft*) Tæniola. (*gb*) Niches of the basal stomach between the tæniola. (*gy*) Pylorus. (*gc*) Central stomach. (*gp*) Palatine opening. (*ga*) Buccal stomach (œsophagus). (*am*) Oral margin. (*oi*) Sense clubs (interradial). (*oa*) Ampullæ at their base. (*bu*) Horseshoe-shaped canal of the marginal lobes (*la*). (*kl*) Peronia between the two limbs of the canal (*bl*). (*tp*) Tentacles (perradial).

perradial pouches, of whose long septa the distal part only remains (in the form of four small nodes). Among the Ephyroniæ (or Discomedusæ), the Cannostomæ only show similar conditions; *Nausithoe* and *Nauphanta* (Pls. XXVII., XXVIII.), and also *Collaspis* and *Atolla* (Pl. XXIX.) have preserved the coronal sinus (*cs*) along with the four primary cathamma (*k*) and their four intermediate perradial fissures up to the present time. In the other Ephyroniæ (Semostomæ and Rhizostomæ), the four cathamma are dissolved and have disappeared; the coronal sinus is consequently merged in the central stomach of which it forms the peripheric part.

§ 135. Peripheric processes of the gastrovascular system. In many lower Medusæ of both sections, the formation of the gastrovascular system is limited to the essential portions of the principal intestine and the peripheric coronal intestine already described. In the majority of Medusæ, however, there are additional, accessory processes of the vascular system, which serve for the nutrition of the peripheric organs. Such pre-eminently are the nutritive canals of the marginal organs, the tentacles and the organs of sense: they run out partly immediately from the distal ends of the radial canals or pouches, partly from the marginal coronal canal, connecting the latter among the Craspedotæ; besides these, special centripetal canals are sometimes developed, which grow out from the annular canal towards the middle of the subumbrella, and serve for the nutrition of the latter. They are found almost exclusively in the order of the Trachomedusæ, and are usually simple with cæcal proximal ends: *e.g.*, as in *Pectis* among the Pectyllidæ (Pl. V. fig. 2; Pl. VI. figs. 11, 20), in *Olindias* among the Petasidæ, and in part of the Geryonidæ (System, taf. xv. figs. 9, 10; taf. xviii. figs. 5, 8). The Cannotid *Spirocodon* is distinguished by dendritic ramification of the centripetal canals (System, p. 636, No. 588). The most remarkable of these peripheric processes of the vascular system among the Acraspedæ are those which pass into the marginal lobes or the velarium formed by their fusion. The velar canals of the Cubomedusæ (Pl. XXVI. fig. 8), the lobe canals of the Discomedusæ belong to this category. In the Typhloperiæ (§ 132), as in the Cubomedusæ, the latter never form anastomoses, whilst in the Cycloperiæ (§ 133) they form by repeated anastomoses a vascular network, varied in form, which often occupies not only the marginal lobes but a large part of the subumbrella (Pl. XXXII. fig. B, § 117). Finally, there are noticeable irregular gelatinous canals, sometimes simple, sometimes branched ("canales endocollares") which in the larger and older Discomedusæ grow out extensively from the coronal intestine into the gelatinous substance of the body (*e.g.*, *Chrysaora*, *Cyanea*, *Pilema*, *Crambessa*).

§ 136. Peripheric openings of the gastrovascular system. In the majority of all Medusæ the central mouth forms the only opening of the gastrovascular system. In single Medusæ of both sections, however, there are also small peripheric openings, which are in every case of a secondary nature. The most important of these are found on the umbrella margin, and may be generally termed marginal pores ("pori marginales").

Among the Craspedotæ the so-called excretory papillæ or subumbral papillæ (also termed marginal funnels or excretory funnels, "papillæ excretoriæ" or "subumbrales") belong to this category. These peculiar excretory organs of the umbrella margin are found exclusively in the order of the Leptomedusæ, among which, however, they are tolerably wide spread. They are small funnel-shaped or conical warts, which project in different numbers, on the distal margin of the subumbrella between the margin of insertion of the velum and the circular canal: they contain an evagination of the circular canal and open by a small aperture into the umbrella cavity (System, p. 119, taf. xi. fig. 13, *ex;* taf. xiii. fig. 5, *q*). Their number in many Eucopidæ (*e.g.*, *Octorchis*) and Æquoridæ (*e.g.*, *Polycanna*) is very considerable but indefinite. The flagellate cells of the endoderm in the subumbral papillæ are directed externally towards the marginal pore, so that the latter must be regarded as an "excretory opening" or "anus." Among the Acraspedæ, similar marginal axial openings have been long known in *Aurelia*, where they lie at the distal end of the eight adradial canals, where the latter open into the coronal canal; the ejection of fluid by these canals can be easily observed directly in the eight adradial marginal pores. These pores also occur in other Ulmaridæ. As, however, they are small and easily overlooked, it is possible that they are much more widespread than we are aware of at present. In some Medusæ, the tentacles seem also to have an opening at the distal end.

§ 137. Reproductive organs (" gonades, genitalia, sexualia," *s*). In all Medusæ the reproductive organs show very simple, homologous, and uniform conditions of formation, inasmuch as they everywhere consist essentially of reproductive glands (" gonades "), and are universally developed in the subumbral wall of the gastrovascular system. The two sexes show no essential difference, as the male spermaria develop in the same places, and in the same way as the female ovaries. On the other hand, there is an essential and thorough distinction between the two sections of the class Medusæ, inasmuch as the subepithelial layer of cells, which, as sexual epithelium or germinal epithelium, furnishes the two kinds of sexual cells, the spermatozoa, and the ova, belongs to the ectoderm in the Craspedotæ, to the endoderm in the Acraspedæ. In the former, the mature reproductive elements are therefore emptied immediately outside into the ectodermal umbrella cavity, whilst in the latter they first pass into the endodermal hollow space of the gastrovascular system, from which they are ejected by the mouth. The Craspedotæ are therefore Ectocarpæ, like the Hydropolyps, Siphonophoræ, and Ctenophoræ, whilst the Acraspedæ are Endocarpæ, like the Scyphopolyps and Corals (§ 19).

§ 138. Gonochorism and Hermaphroditism. Nearly all known Medusæ are of separate sexes, gonochoristic, only a very few are hermaphrodite. The Pelagic *Chrysaora* certainly belongs to the latter (System, p. 503, taf. xxxi.). Here, whilst the four interradial genitalia produce ova, roundish spermaria or testes-like sacs are simultaneously formed in very irregular number on the most varied parts of the sumbumbral wall of the gastrovascular system, both in the genitalia, and on the oral arms, and also on different parts of the principal intestine, and of the coronal intestine, and even in the peripheric coronal pouches. *Chrysaora* is usually purely male in youth, hermaphrodite later on, and purely female when mature; it seems, however, also to furnish purely gonochoristic specimens, which during their whole lifetime form purely male or purely female sexual cells. Hermaphroditism similar to that of *Chrysaora* seems also to exist in the closely allied Linergidæ; the peculiar, regularly distributed subumbral vesicles of these Cannostomæ appear to develop spermatozoa, whilst their genitalia only produce ova (System, p. 493, taf. xxix.). Among the Craspedotæ part of the Narcomedusæ appear to be hermaphrodite; these and some other (probable) cases of hermaphroditism are not known with sufficient certainty. The sperm cells of the Medusæ are universally fine flagellate cells, not strikingly distinguishable from those of other Acalephæ. The egg cells are usually naked and amœboid in the Craspedotæ (Pl. I. fig. 8) but usually enclosed in fulcral capsules in the Acraspedæ (Pl. XX. fig. 7); in some Acraspedæ they contain a visible food-yolk and then come to more than 1 mm. in size (Pl. XXV. fig. 4).

§ 139. Genitalia of the Craspedotæ. The reproductive glands are developed in all Craspedotæ (in thorough and important contrast to the Acraspedæ) from the ectoderm of the subumbral wall of the gastrovascular system, and when mature, are emptied immediately into the umbrella cavity. They are sometimes formed more in the central part of the gastrovascular system, sometimes more in the peripheric part; in the first case we call them gastral genitalia, in the second case, vascular genitalia. Gastral genitalia in the subumbral wall of the central stomach, and the œsophagus proceeding from it, are found in the two orders of the Anthomedusæ (Pl. I.), and the Narcomedusæ (Pls. X.–XII.), whilst on the other hand, the two orders of the Leptomedusæ (Pl. II.), and the Trachomedusæ (Pls. III.–VIII.) have vascular genitalia in the subumbral walls of the peripheric radial canals. There are, however, isolated exceptions in both groups; the central gastral genitalia sometimes grow centripetally and extend from the stomach also on to the peripheric canals (*e.g.*, *Nemopsis* among the Anthomedusæ, System, taf. v. figs. 6–9); in many they even pass mostly or entirely on to the gastral pouches of this order, which originate from the proximal part of the radial canals (Pls. IX., XIII., XIV.). In other cases the reverse occurs, and the peripheric vascular genitalia extend upon the central stomach (*e.g.*, *Staurostoma*, *Staurophora*, *Orchistoma* among the Leptomedusæ, System, taf. viii. fig. 6; taf. xv. figs. 3–5). If we consider the Craspedotæ to be a monophyletic group of animals, the gastral production of the genitalia may probably be regarded in general as the older and original condition from which the vascular production of the reproductive glands has been developed later, or we may assume that the subumbral wall of the entire gastrovascular system originally produced sexual cells, and that these productions were distributed later on the principal intestine and coronal intestine. If on the contrary (and with more probability) we consider the Craspedotæ as a polyphyletic group, the vascular genitalia and the gastral genitalia may have arisen in the different orders, independently of one another.

§ 140. Gastral genitalia of the Craspedotæ. The simplest and most primitive condition of the genital formation is shown in the section of the Craspedotæ in such genera as have only a simple reproductive organ, a circular genitalium in the subumbral gastral wall, having the mouth placed in the middle. This condition is shown by the Codonidæ among the Anthomedusæ, and also by isolated genera among the Anthomedusæ. The Codonidæ (System, p. 10, taf. i., ii.) are distinguished by a long thin œsophagus, extending in a vertical direction, in whose wall the reproductive cells are regularly developed, so that the genital ring keeps the form of a cylindrical tube. In contrast to this formation the Narcomedusæ have a flat, broad, gastral sac, extending in a horizontal direction, so that the genital ring in its subumbral wall likewise appears flat and broad (*Polycolpa*, Pl. X. fig. 1). Whilst in many Narcomedusæ, the central genital ring remains quite simple, in others, it extends centripetally on to the peripheric radial pouches, and in many it is finally limited to the radial pouches. It is divided into the same number or double the number of separate genital pouches, which originally appeared as radial canals (comp. the System der Medusen, pp. 312, 327, 335, 347, taf. xix., xx.). In *Æginura* (Pls. XIII., XIV.), the genitalia are formed by sixteen internemal gastral pouches, in *Pegantha* (Pl. XIII. fig. 3) by a corona of separate sacs, which evaginate separately into the periphery of the stomach and hang down in the separate subumbral lobe cavities of the umbrella corona (Pl. XI. fig. 3). In most Anthomedusæ the originally simple genital ring (in the Codonidæ) is divided in the same way, in four or eight radial pieces. The radial division first takes place by the four interradial areæ remaining free from sexual production, whilst four perradial genitalia lie in the four angles of the stomach (System, taf. iii. figs. 1, 2; taf. iv. 1, &c.). Each of these may, however, be re-divided into two halves, which are separated by the perradial longitudinal muscle of the angles of the stomach (*Thamnostylus*, Pl. I.; System, taf. iv., figs. 3, 10). Finally, these eight adradial reproductive glands may be placed near each other and fused in the four interradia in such a way that the inverted limbs of each two adjacent genitalia, originally separate, are connected into a single gland; so that, finally, there are four interradial genitalia in the side walls of the stomach (System, taf. v. figs. 1, 3; taf. vi. fig. 3, 15, &c.). We have, therefore, apparently the same condition as in many Acraspedæ; only in the latter, the interradial position of the four bow-shaped genitalia is a primary appearance, whilst in the Craspedotæ it is secondary (or rather tertiary).

§ 141. Vascular genitalia of the Craspedotæ. In antithesis to the gastral genitalia of the Anthomedusæ and Narcomedusæ, we find in the Leptomedusæ and Trachomedusæ the reproductive glands are usually limited to the subumbral wall of the radial canals, of which they sometimes occupy the entire length, sometimes only a part of it (proximal, middle or distal part). As in most Craspedotæ the number of the radial canals amounts to four, they are usually also four perradial genitalia (Pl. II.). This primitive number is doubled in those Craspedotæ in which four secondary interradial canals have arisen between the four primary perradial (Melicertidæ, Octocannidæ, Aglauridæ, Pectyllidæ, Pls. III.-VIII.; System, taf. viii. fig. 10; taf. xvi., xvii.). In the Æquoridæ, where the number of the radial canals multiplies indefinitely (20-80 and over), the number of the genitalia fastened to them increases correspondingly (System, taf. xiv., xv.). In the simplest case, each reproductive gland forms a simple, ridge-shaped thickening in the subumbral wall of each radial canal. In many Craspedotæ, however, this ridge is divided into two lateral halves, between which the median line of each wall remains free from the sexual products. The two paired halves of these reproductive ridges lie further asunder in proportion to the developement of a longitudinal radial muscle in this median line (Pl. VIII. fig. 9). They sometimes hang down in the umbrella cavity as two parallel folds (*e.g.*, Æquoridæ), sometimes extend like leaves in the surface of the subumbral wall (Geryonidæ). The canal usually forms a cæcal evagination into the genital ridge on the subumbral wall of the radial canal, whether it remains simple, or is divided into two paired halves, so that it assumes the form of a pendant vesicle, sac, or tube (Pls. III.-VIII.). Further complications in its formation also arise when the genital band is arranged in folds; the depressions between the separate folds may also become so deep that it is divided into numerous separate vesicles (*e.g.*, *Olindias*, System, taf. xv. fig. 11). The Octorchidæ, a sub-family of the Eucopidæ, are distinguished by each of the four genitalia, being divided into two pieces lying far apart; the proximal part lies on the ascending radial canal of the umbrella peduncle (fig. N, s^2), the distal part on the descending radial canal of the subumbrella (fig. N.s', p. 190); here eight genitalia also come on four radial canals.

§ 142. Genitalia of the Acraspedæ. The reproductive glands in all Acraspedæ (in constant and typical contrast to the Craspedotæ) are developed from the endoderm of the gastrovascular system. The sexual products in process of development first appear from the subepithelial germinal layer, in the depth of the gelatinous mesoderm, and are there enclosed in special fulcral capsules (Pl. XXV. fig. 7, *zz*). When mature, they break through these chorion sheaths, and fall freely into the gastral space from which they are emptied out through the oral opening. In the Acraspedæ, as in the Craspedotæ, the formation of the reproductive cells takes place sometimes more in the central part of the gastrovascular system, sometimes more in the peripheric part. Whilst in the Craspedotæ, the central gastral genitalia appear to be the primary formation, and the peripheric vascular genitalia to be derived secondarily from them, in the Acraspedæ, the development of formation is probably reversed. It is precisely the older and more simply constructed Tesseroniæ (the Stauromedusæ, Peromedusæ, and Cubomedusæ), that have bursal genitalia, which are developed in the subumbral wall of the four wide radial pouches, or of the wide peripheric coronal connecting them; in the younger and more highly developed Ephyroniæ (the Discomedusæ), the genitalia pass more and more centripetally from the subumbral wall of the radial pouches or peripheric coronal sinus, or to the subumbral wall of the broad, flat central stomach, so that they here appear again as gastral genitalia. Another still more important distinction between the two sections consists in the fact that in the Craspedotæ the four radial pieces of the reproductive apparatus lie originally perradially, whilst on the contrary, in the Acraspedæ they lie originally interradially. Whilst in the Ephyroniæ, among the Acraspedæ, there are usually four interradial glands (more rarely divided into eight pieces), in the Tesseroniæ, on the contrary, there are usually eight separate pieces, which, however, always belong in pairs to the four interradial genitalia.

§ 143. Bursal genitalia of the Acraspedæ (Tesseroniæ). In all Tesseroniæ the central stomach remains free from the sexual productions, and the reproductive glands are exclusively, or for the most part, developed in the subumbral wall of the four perradial pouches. In the most simple case, four interradial horseshoe-shaped glands are formed, which include the four interradial cathammal nodes (*kn*) or the proximal ends of the four narrow septal ridges (*ks*) in the concavity of their U-shaped proximal ends, whilst the two limbs of each arch project into the two adjacent perradial pouches (Pl. XV. figs. 2–6). The oldest and simplest of all Acraspedæ, the Tesseridæ (System, taf. xxxi.), and some of the closely allied Lucernaridæ (*Halicythus*), show this most simple and apparently original condition. In all other Tesseroniæ (and also in most Lucernaridæ and in all Peromedusæ and Cubomedusæ) each of the four interradial genitalia is divided into two separate halves, as the convex proximal ends of the horseshoe-shaped gland (which encloses the cathammal nodes) have undergone retrograde formation and disappeared, so that only the two limbs remain. These lie on the two sides of the interradial

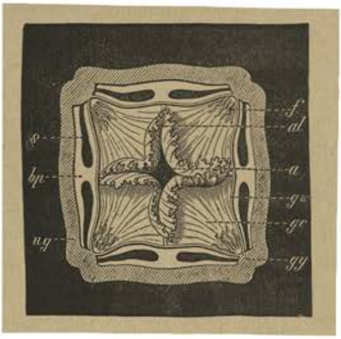


Fig. P. *Procharagma prototypus* (Cubomedusæ, Charybdeidæ).

Horizontal transverse section below the stomach, whose subumbral wall (*gc*) is completely visible, in the middle, the oral opening (*a*) with the four perradial oral lobes (*al*). The gastral filaments (*f*) are placed upon the four interradial pyloric valves (*gy*). (*gw*) Subumbral wall of the two gastral pouches (*bp*). (*s*) Genitalia. (*ug*) Gelatinous substance of the umbrella.

cathammal septum belonging to them, but in two different perradial pouches, so that each pouch contains the inverted halves of two adjacent pairs of genitalia. In the Lucernaridæ (Pls. XVI.–XVII.) and in the Peromedusæ (Pls. XVIII.–XXV.) the eight reproductive glands, which are connected in pairs, lie as leaf-shaped swellings in the subumbral wall of the four perradial pouches themselves. In the Cubomedusæ (Pl. XXVI.), on the other hand, they are only connected with the four perradial pouches by a narrow marginal insertion (immediately next to the fused streak of the cathamma but on its subumbral side), and otherwise project as eight free genital leaves into the hollow space of the pouches, of which they occupy the larger part (fig. P, *s*; System, taf. xxi.–xxvi.). In the different Tesseroniæ we find many stages of development in the structure of the genitalia. In the simplest case, in the Tesseridæ, the sexual glands are merely simple ridges or pads, originated by wheel-shaped thickenings of the endoderm of the subumbral wall (like the most simple vascular genitalia of the Craspedotæ); a corresponding ridge of the fulcral lamella serves as supporting frame ("sterigma") for the subepithelial germinal cells. Further (in part of the Peromedusæ), more or less complicated folds are formed, which rise above the subumbral wall and project freely into the space of the pouches; the supporting frame of the fulcral plate ("sterigma") likewise rises higher and attains greater development (Pls. XXIII. fig. 38, 39; Pls. XXV. fig. 5–7). In the Cubomedusæ the sterigma is developed into a broad, thin leaf, which is only connected with the supporting plate of the subumbrella at the base of insertion (near the cathammal ridge), and bears sexual cells on both its free surfaces (axial as well as abaxial); its freer margin is sometimes lobed or branched dendritically (*Chirodropus*, System, taf. xxvi.). The reproductive glands attain their most complicated structure in the Lucernaridæ (System, p. 386). Each of the eight reproductive leaves is here divided into numerous, separate follicles, each containing a genital sinus with excretory passage, and each follicle is sometimes again composed of a number of smaller sacs (Pl. XVII. figs. 17–19).

§ 144. Gastral genitalia of the Acraspedæ (Ephyroniæ). Whilst in all Tesseroniæ the subumbral wall of the four perradial pouches is the place of origin of the reproductive glands, in the Ephyroniæ or Discomedusæ it has migrated centripetally from the pouch wall to the subumbral wall of the central stomach. This centripetal change of locality must therefore be phylogenetically considered as secondary, since the younger and more highly developed Ephyroniæ are clearly derivable from the older and more simply constructed Tesseroniæ, and since the lowest and oldest grades of development of the former present points of connection with the latter. In some Cannostomæ (especially some Ephyridæ) in which the four primary interradial cathammal nodes are still preserved, we still find four interradial horseshoe-shaped genitalia, which enclose the nodes by their concave proximal arches and whose distal diverging limbs still lie in the subumbral wall of the coronal sinus or of the four perradial pouches (System, pp. 467, 480, 492; taf. xxvii., xxviii., xxix.). The pairs of limbs are here often divided into separate halves, as the connecting proximal arch has become lost (*Nauphanta*, Pl. XXVII., XXVIII.; *Atolla*, Pl. XXIX.). Whilst the first and oldest order of the Discomedusæ, the Cannostomæ, still present more or less the original genital conditions of the Tesseroniæ, these have disappeared entirely in the other Discomedusæ, in all Semostomæ and Rhizostomæ. As here the four primary cathammal nodes are resorbed, and both the four perradial pouches, separated by them and the coronal sinus are consequently merged in the flat central stomach, four simple interradial genitalia usually lie in the subumbral wall of the central stomach, lying nearer its centre in proportion as the Ephyroniæ character is more highly developed and the peripheric umbrella corona becomes extended at the cost of the central umbrella disk. The delicate, thin gastrogenital membrane (*gg*) on whose endodermal inner surface the four genitalia are situated, is certainly simply termed the bottom of the stomach or subumbral wall of the central stomach; but it must always be borne in mind

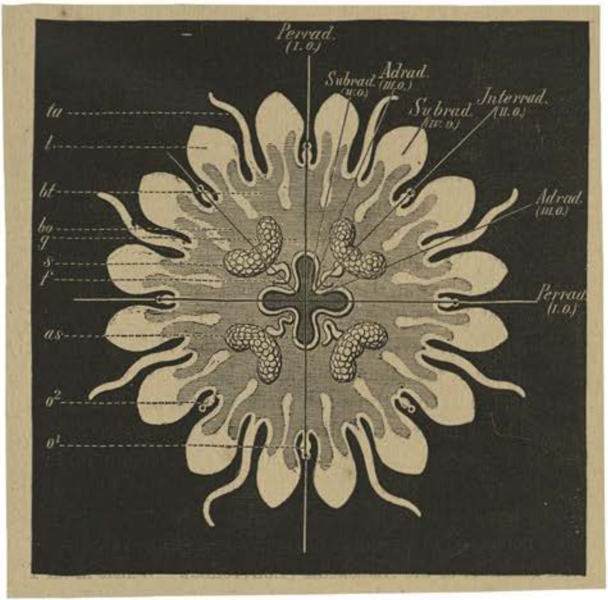


Fig. Q. *Zonephyra pelagica* (Discomedusa, Ephyrida).

Subumbral view, giving the four orders of transverse axes (with twice as many radii). The oral cross (*as*) and the four perradial sense clubs (*o'*) lie in the four perradii (Order I.). The gastral filaments (*f*), the genitalia (*s*), and the four interradial sense clubs (*o²*) lie in the four interradii (Order II.). The eight tentacles (*ta*) and the tentacular coronal pouches (*bt*) lie in the eight adradii (Order III.). The sixteen marginal lobes (*l*) lie in the sixteen subradii (Order IV.). Sixteen bifurcate coronal pouches, eight tentacular (*bt*) and eight rhopalar (*bo*) radiate from the central stomach (*g*).

that it is only its axial or proximal part which really deserves this name, whilst its abaxial or distal part rather corresponds originally to the subumbral wall of the coronal sinus and the four perradial pouches at its proximal margin, which have become merged in the central stomach in consequence of the dissolution and resorption of the four interradial cathamma. The delicate gastrogenital membrane is frequently (namely, in the Pelagidæ and Cyaneidæ) evaginated downwards out of the gastral cavity (like a hernia), and forms four pendent gastrogenital pouches, in the bottom of which the four frill-shaped genital bands lie ("extraversio gonadum," Pls. XXX., XXXI.; System, p. 470, taf. xxx.). In most Rhizostomæ, on the contrary (and also in the Aurelidæ), the thin gastrovascular membrane invaginates inwards into the gastral cavity (like a replaced hernia "intraversio gonadum," System, p. 470, taf. xxxiv.–xl.). If the four invaginated inner gastrogenital pouches approach each other in the centre so that they touch, they may become fused together and enter into communication by breach of the fused walls. In this way there arises the remarkable formation, which has been already described, of the "subgenital vestibule," of which the roof is formed by the cruciate gastrogenital membrane, the floor by the brachial disk (comp. above § 96, p. lxxvii., woodcut, figs. G and H, and Pl. XXXII.; also in the System, pp. 471–473, taf. xxxviii.–xl.). These and other modifications of the gastrogenital formation of the Ephyroniæ have already been described comparatively in the System der Medusen (1879, pp. 467–473). They are all derivable from the four simple horseshoe-shaped genitalia, which we find in the subumbral wall of the periphery of the stomach (or of the coronal sinus) in *Ephyra*, the oldest and simplest form of the Discomedusæ (fig. Q). In this and other morphological respects, *Ephyra* remains one of the most important types among all Medusæ.

DESCRIPTION OF THE SPECIES.

Class I. CRASPEDOTÆ, Gegenbaur, 1856.

Cryptocarpæ, Eschscholz, 1829. Gymnophthalmæ, Forbes, 1848.
Hydromedusæ, Carus, 1863. Aphacellæ, Hæckel, 1878.

Medusæ without gastral filaments or phacellæ; with ectodermal genitalia (or sexual products formed from the external germinal layer); with a true velum (always without a velarium); without true marginal lobes of the umbrella; with double centralised nerve-ring. Phylogenetic descent (probably universal) and ontogenetic descent (now established for the majority) derived from hydroid-polyps without gastral filaments or from hydrostomæ. Ontogenesis chiefly alternation of generations, often with metamorphosis. The sexual craspedote generation is formed by lateral gemmation from the asexual hydrostoma generation.

Order I. ANTHOMEDUSÆ, Hæckel, 1877.

Craspedotæ without marginal vesicles and otolites, with ocelli at the bases of the tentacles. Genitalia in the external or oral wall of the stomach. Number of the radial canals almost always four, very rarely six or eight. Ontogenesis chiefly alternation of generations, often with metamorphosis. The trophosome of the asexual generation is a hydroid-polyp of the order Tubulariæ.

Family, Margelidæ, Hæckel, 1877.

Margelidæ, Hæckel, System der Medusen, 1879, p. 68, taf. v., vi.

Anthomedusæ with four or more simple or branched oral styles, with four or eight separate genital sacs in the wall of the stomach, with four narrow simple radial canals, and with simple unbranched tentacles, which are sometimes distributed equally, sometimes grouped in four or eight bundles.

Sub-family, Thamnostomidæ, Hæckel, 1867.

Margelidæ with branched or compound oral styles, and tentacles equally distributed, not grouped in bundles.

Thamnostylus,[1] Hæckel, 1879.

Margelidæ with branched or compound oral styles and only two opposite perradial tentacles.

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[1] Θάμνος, bush ; στῦλος, style.

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The genus *Thamnostylus* with the single species *Thamnostylus dinema* (Pl. I.) is the only deep-sea Anthomedusa which I found among the collections of the Challenger expedition. It belongs to the family of the Margelidæ, to the sub-family of the Thamnostomidæ, and is the only dissonematous genus of this sub-family, with only two developed opposite marginal tentacles (like *Cubogaster* among the Cytaeidæ).

The genus *Thamnostylus* is distinguished by the remarkable development of the oral organs; the long central œsophagus, which projects below far out of the central stomach, and the four strong numerously branched oral styles which spring from its basis are much larger in proportion to the rest of the body in *Thamnostylus* than in the other Margelidæ. In other respects *Thamnostylus dinema* appears at the first glance a very abnormal and peculiarly formed Anthomedusa. Closer consideration and comparison with other Craspedotæ shows, however, that its structure is not special or peculiar to itself. We rather find in it a peculiar combination of striking characters, which appear otherwise combined in other Anthomedusæ. The Margelidæ *Limnorea triedra* and *Favonia octonema* described by Péron (1809) appear to come nearest to it (Péron, Tableau des Méduses, No. 8, Annales du Museum d'Hist. Nat., tom. xiv. p. 329). Leseur has given a very good figure of both (in pl. iii. of his Recueil des Planches inédites des Méduses, figs. 3, 5), which clearly shows a near relation to *Thamnostylus* and *Nemopsis*. Here the œsophagus also projects out of the umbrella cavity, and is surrounded by a bush of blood red much-branched oral styles which spring from its basis. On the ground of these figures (which have been copied by Blainville (1834) and Milne-Edwards (1849), L. Agassiz has placed *Limnorea* and *Favonia* among the Rhizostomata. (Compare my System der Medusen, 1879, p. 87, and also the figure of *Nemopsis heteronema*, p. 93, taf. v. figs. 6–9).

Thamnostylus dinema, Hæckel (Pl. I.).

Thamnostylus dinema, Hæckel, 1879, System der Medusen, p. 85, No. 95.

Umbrella hemispherical, twice as broad as high. Stomach quadrangularly pyramidal, reaching almost to the plane of the velum. Genitalia four egg-shaped swellings in the wall of the stomach; œsophagus quadrangularly prismatic, twice as long as the stomach, projecting far out of the umbrella cavity; four oral styles a little shorter than the œsophagus, springing from its basis, 6 to 8 times dichotomised; two opposite long, strong tentacles, several times longer than the breadth of the umbrella. Horizontal diameter of the umbrella, 16 mm.; vertical diameter, 8 mm.

Habitat.—Antarctic Ocean, south from the Kerguelen Islands. Station 153. Lat. 65° 42′ S., long. 79° 49′ E. Depth, 120 fathoms.

The form of the umbrella is almost hemispherical, half as high as its greatest breadth somewhat above the umbrella margin. The gelatinous substance thick, gradually and regularly thinning out towards the margin. The exumbrella (or the external convex surface of the umbrella) has a finely punctured appearance, as small round, stinging papillæ are scattered equally over it (fig. 1). The subumbrella (or the inner concave surface of the umbrella) shows a strong annular muscular system, and eight narrow radial or longitudinal muscles, of which four perradial (*mp*) accompany the four radial canals, and four interradial run in the middle between the radial canals (*mi*). Their proximal ends pass into the longitudinal muscles of the stomach and the œsophagus. The velum projects from the umbrella margin towards the interior as a somewhat broad muscular membrane, and narrows the entrance to the umbrella cavity considerably. The umbrella cavity itself is flat and limited in size as the central third of it is occupied by the large gastral pyramid with the reproductive sacs.

The umbrella margin is thickened into a roll, and pigmented red. At the points where the four perradial canals open into the marginal circular canal, the rim of the umbrella margin swells into four thick ocellar-bulbs with dark red pigment. Of these the two opposite are without tentacles, whilst the two others, alternating with the former, bear very long and strong tentacles (fig. 1). These are several times longer than the diameter of the umbrella, cylindrical, thickened like a club at the base, and beset with rings of thread-cells along the entire length.

Gastrovascular system. The central part consists of the quadrangularly pyramidal central stomach, in whose wall the reproductive sacs lie; and of the projecting œsophagus, double the length of the central stomach, from whose basis spring the four multibranched bunches of the oral styles. The peripheric part of the gastrovascular system consists of the four perradial canals which spring from the basis of the central stomach and open into the circular canal at the umbrella margin ; a canal passes from the latter into each of the two tentacles, and traverses its whole length. These two tentacle canals, as well as the four radial canals and the circular canal uniting them, are rather narrow and ribbon-shaped, and show nothing special. On the other hand, the central part of the alimentary apparatus has a somewhat complicated construction.

The central stomach (figs. 1–3, *gc*) has the form of a quadrangular pyramid whose height is nearly equal to the diagonal of its basis, and whose truncated end, which has a downward direction, is the starting-point of the long œsophagus and of the four tree-like oral styles. The quadrate basis of the quadrangular stomach pyramid occupies the central third of the subumbrella, and is formed by the lower surface of the gelatinous umbrella ; the four radial canals open into the central cavity at the four angles of the square, and pass thence in the form of semi-cylindrical grooves to the four perradial corners of the gastral pyramid. The thickened wall of these grooves forms the midrib of the four leaf-shaped genitalia or pinnated "reproductive leaves."

Genitalia. Each reproductive leaf forms an egg-shaped swelling, with the rounded basis turned upwards and the truncated point turned down. As four to five deep transverse grooves on both sides of the midrib divide the genitalium into the same number of lobes, it assumes the form of a delicate pinnated leaf. Its five to six pairs of pinnules become longer from the top to the bottom and are delicately notched at the edges like many fern-fronds (fig. 6). Numerous large and small ova appear lying very closely together on the upper surface of the single pinnated leaves. The ova are large, naked amœboid cells, of irregular roundish or polyhedral outline, which enclose a large clear germinal vesicle. In this nucleus a dark germinal spot of considerable size (nucleolus) is visible which contains a distinct nucleolinus (fig. 8). The four reproductive leaves occupy the greater part of the thickened wall of the central stomach, so that only four narrow interradial areæ of its external surface are free from them (fig. 3). More minute investigation, however, shows that only the perradial midrib and the aboral basal parts of the reproductive leaves are integrate portions of the wall of the stomach itself, from the ectoderm of whose angles they are developed. On the other hand, the oral points of the genitalia and the larger part of their lateral margins are free, and only lie superficially on the external wall of the stomach. Between the colourless ova, as in the remaining parts of the wall of the stomach and of the umbrella margin, there are numerous fine granules of the same blood-red pigment (insoluble in spirit of wine) which causes the red colour of the oral styles and of the stinging capsules of the tentacles.

The oral styles (" stomostyli," figs. 1–5). In this species, as in several other Margelidæ (*Hippocrene*, *Nemopsis*, *Rathkea*, *Limnorea*, &c.), the characteristic oral styles form extremely delicate multi-branched bunches, distinguished by their blood-red colour. These branches are, however, more numerously and more strongly developed here in proportion to the rest of the body than in all the other Margelidæ. When fully extended (as it appears in the particular specimen before us) they occupy a space exceeding that of the whole umbrella. The four perradial strong stems of the oral styles are nearly as thick as the swollen basal pieces of the tentacles and spring from the truncated point of the central stomach round about the basis of the long œsophagus almost at the height of the plane of the velum (fig. 1). Each of the four strong stems divides directly into two thick principal branches, which again bifurcate after a short course. These branches appear to dichotomise at least six or eight times (sometimes oftener), so that the aggregate number of the terminal branches amounts to more than a thousand. The calibre of the branches becomes smaller with each new bifurcation, so that the four basal principal stems are at least six to eight times as thick as their terminal branchlets. Each of the latter ends with a spherical stinging knob, which is composed of numerous longitudinally extended, radially placed thread cells, and bears long fine cnidocils (fig. 5 *n*). The minute structure of the oral styles and their branches is the same as in other Margelidæ. Their principal mass forms an endodermal cellular axis, consisting of a single row of flat coin-shaped endoderm cells placed in series like a rouleau of money. Their nuclei, surrounded by an area of protoplasm, lie in their centre (fig. 5 *d*), and distinctly form a connected axial cord in the centre of the whole column of cells (which in the solid oral styles of other Margelidæ, as in the similar tentacles of the Narcomedusæ and many hydroids, were erroneously considered by former observers to be a "central canal"). This solid endodermal cellular axis is surrounded by a thin, but firm and very elastic, strongly refringent, supporting lamella, by whose elasticity the extension of the contracted oral styles is effected on the cessation of the contraction of the muscle (figs. 5–7, *z*). The muscles, which in a great measure shorten and at the same time thicken the oral styles by their contraction, form a thin lamella, composed of longitudinal, parallel fibres. This muscular plate, here as in the tentacles, is a product of the ectoderm, whilst the elastic lamella is secreted by the endoderm. The ectoderm covering of the oral styles consists of flat epithelial cells which partly form flagellate capsules, partly stinging capsules, and also contain numerous granules of blood-red pigment. The stinging cells of the end knobs are not pigmented.

The œsophagus or "gullet," which may also be termed "proboscis," and which springs from the oral opening of the central gastral pyramid in the centre between the four stems of the oral styles, is two or three times as long as the gastral pyramid, and projects far beyond the velar opening of the umbrella cavity. It is quadrangularly prismatic, of equal thickness in the two upper thirds, whilst the lowest third is swollen into an egg-shaped pharynx without muscles. The latter is divided from the lowest part of the œsophagus, which bears the quadratic oral opening, by a circular constriction ("strictura palatina") (fig. 4). The thickened oral edge bears a circle of stinging knobs (figs. 4, *an*). The four perradial corners of the œsophagus project strongly, whilst the concave lateral surfaces lie in folds.

Order II. LEPTOMEDUSÆ, Hæckel, 1866.

Craspedota partly without, partly with marginal vesicles, these, when present, developed from the insertion of the velum, with ectodermal otolite cells. Ocelli at the bases of the tentacles sometimes present, sometimes wanting. Genitalia always in the course of the radial canals. Number of the radial canals varying, sometimes four, six, or eight, sometimes very large, sixteen, thirty-two, eighty, or even several hundred. Velum thin and delicate. Ontogenesis, usually alternation of generations, often with metamorphosis. The trophosome of the asexual generation is a hydroid-polyp of the order Campanulariæ.

Family, CANNOTIDÆ, Hæckel, 1877.

CANNOTIDÆ, Hæckel, System der Medusen, 1879, p. 140, taf. ix.

Leptomedusæ without marginal vesicles, with four or six radial canals, which are branched, forked, or pinnated, in whose course the genitalia lie.

Sub-family, Polyorchidæ, A. Agass., 1862.

Cannotidæ with four or six radial canals, which are pinnated, or furnished with cæcal side branches which do not reach into the circular canal.

Ptychogena,[1] A. Agass., 1865.

Cannotidæ with four pinnated radial canals, whose alternating pinnated branches bear several leaf-shaped cleft, indented or compound genitalia. Stomach a flat, wide pouch, without special oral lobes.

The genus *Ptychogena* was established by A. Agassiz, in 1865, for the North American deep-sea form, *Ptychogena lactea* (North American Acalephæ, p. 137, fig. 220). A second somewhat different deep-sea species from the North-Atlantic Ocean (*Ptychogena pinnulata*) is here described, and completes Agassiz's short definition. *Ptychogena* is the connecting link between the apparently very different genera *Gonynema* and *Staurophora*. Whilst the stomach is a long tube in *Gonynema*, and is entirely rudimentary in *Staurophora*, in *Ptychogena* it forms a flat, wide-opened quadrate pouch, whose four corners pass conically contracted without definite limits into the four radial canals; and whilst in *Gonynema* the pinnated branches of the genitalia are entirely limited to the radial canals, but in *Staurophora* run centripetally to the centrum of the cross of these canals, they are developed in an intermediate degree in *Ptychogena*. They there occupy only the proximal half of the radial canal, but pass from it some distance upon the wall of the stomach. Both North Atlantic species of *Ptychogena* appear to be true deep-sea Medusæ. A. Agassiz writes of it as follows (*loc. cit.*, p. 139):—

"This Medusa, like *Tima*, swims at a considerable depth below the surface. The action of the light and increase of temperature of the surface is sufficient to kill them in the course of half an hour; the moment they are brought to the surface the spherosome loses its transparency, the genital organs become dull, and the Medusa is soon completely decomposed. This action is much more rapid than anything I have noticed even in Ctenophoræ, *Mertensia* being the only genus in which the decomposing effects of light and heat are at all equal to what is produced here. This Jellyfish must be a deep-water species, as they have only been found during a single fall, and then only for a few days, when they seemed quite abundant."

These remarks most probably are applicable to *Ptychogena pinnulata* as well as *Ptychogena lactea*. The example of the former in the Challenger collection was found at a depth of 1250 fathoms.

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[1] Πτυχή, turning; γενή, reproductive organs.

Ptychogena pinnulata, Hæckel (Pl. II.).

Ptychogena pinnulata, Hæckel, 1879, System der Medusen, p. 148, No. 150.

Umbrella depressed, three to four times as broad as high. Stomach quadrangular, very flat and wide, one-third of the diameter of the umbrella, with slightly-raised oral margin, which is prolonged at the corners into four short lobes. Genitalia, four broad, almost circular, pinnated leaves, which occupy the proximal half of the radial canals, at whose conically-enlarged origin they pass into the wall of the stomach, each leaf with twenty to thirty pairs of alternating pinnated branches, which are not divided, and which bear leaf-shaped, deeply-notched reproductive lobes at the lower free margin. Two to three hundred long tentacles with numerous marginal clubs between. Horizontal diameter of the umbrella, 50–60 mm.; vertical diameter, 20–30 mm.

Habitat.—North Atlantic Ocean. I was able to investigate several well-preserved specimens in spirit of this North Atlantic species from the Copenhagen Zoological Museum, which had been found by Captain Moberg between Ireland and Iceland (lat. 59° 7′ N., long. 13° 32′ W. from Greenwich). A fragment of a Cannotid, which I discovered in a jar of the Challenger collection, from Station 50 (May 21, 1873), in the same jar as *Pectyllis arctica* (dredged near Halifax from a depth of 1250 fathoms, lat. 42° 8′ N., long. 63° 39′ W.), appears identical with these specimens. Although this decomposed fragment hardly included the quadrant of a disc, it was still sufficient to identify it completely with these Copenhagen specimens from which the following description and drawing are taken.

Ptychogena pinnulata shows, on the whole, the same formation of the umbrella as the closely-related *Ptychogena lactea* (*loc. cit.*). The umbrella is depressed, projecting somewhat more strongly in the centre. The horizontal breadth at the opening of the umbrella cavity is from two to three times as great as the vertical height. The gelatinous substance of the umbrella is tolerably firm, but thin, and diminishes in thickness rather rapidly from the centre towards the margin; in the centre its thickness amounts to 5 or 6 mm. The exumbrella is smooth, without special distinct characters.

The umbrella margin is thickly beset with two rows of appendages, an outer row of long tentacles, and an inner row of short marginal clubs (figs. 3, 4). The number of tentacles or marginal filaments amounts to from 200 to 300; in one specimen I counted 320. There are usually from 70 to 80 upon each quadrant. They lie thickly pressed together. The swollen basis or tentacle bulb is 1·8 mm. long, 0·6 mm. broad, and has the form of a half-oval leaf lying in the meridian plane. The abaxial margin is strongly arched, rising gradually from the basis, and then falling off rapidly. The axial margin is straight or sinuated a little concavely. The marginal filament itself is very thin, and in the spirit specimens before me nearly as long as the diameter of the umbrella; in the living animal probably three or four times as long. The marginal clubs, or tactile clubs (figs. 3, 4, *ok*), lie on the inner side of the tentacles between their insertion and the basis of the velum. In some places they alternate with the tentacles, but are usually irregularly distributed. Their number appears very variable. In one of the three specimens before me there are very few (20 to 30), in the second above 100, and in the third over 200. The opaque marginal clubs appear chalk-white in reflected light, black in transmitted light. They are pyriform, gradually enlarging from a narrow stalked base about one-third to one-half as long as the basal bulbs of the marginal filaments, 0·6 to 0·8, at the most 1 mm. long and 0·3 mm. broad. Treated with acid, they show a narrow canal (fig. 8). The velum (*v*) is rather broad, but very thin and delicate, and with many folds. The system of circular muscles of the subumbrella is moderately developed, and shows no special peculiarities. The umbrella cavity is very shallow, its upper half filled up in a great measure by the stomach and the four genitalia.

The wide oral opening leads into a short, shallow gastral sac, whose four basal corners are extended into four conical funnels. These pass into the four radial canals, which are pinnated in their proximal half and bear the genitalia (figs. 1, 2). The narrow radial canals open at the umbrella margin into an annular canal, which sends branches into the tentacles and marginal clubs (fig. 8).

The oral opening (figs. 1, 2 in the centre) is quadrate, very wide, with irregularly frilled borders, extending at the four perradial corners into four short wavy oral lobes (fig. 2, *al*). The thin transparent wall of the quadrangularly prismatic gastral tube hangs down nearly to the middle of the umbrella cavity; its lower free oral margin is much thinner. A perradial cross (fig. 2, *g*) whose four limbs are 0·5 mm. broad and 8 mm. long, appears very plainly in the fundus of the stomach on the gastral surface of the gelatinous umbrella. This cross is formed by four very narrow ciliated grooves which are centripetal processes of the umbrella wall of the four radial canals. In one of the three examples the four limbs of the cross meet in the aboral centre-point of the subumbrella, so that the quadrate ground of the stomach is divided into four congruent equally limbed triangles (fig. 2). In the other two examples the points of the two opposite triangles are truncated and rest (at one specimen at the length of 2 mm. in the other at 6 mm.) in such a way that opposite points of the two other alternating triangles remain at about the same distance from each other (fig. 7). The geometrical form of the ciliated cross is here plainly amphitect, whilst it is completely regular in the first specimen (fig. 2).

The four perradial corners of the fundus of the stomach are prolonged into four conical funnels (fig. 2, *ck*) whose ends extend to the middle of the genitalia and occupy the proximal half of the radial canals. The latter are very broad in the proximal half, and, on the other hand, very narrow in the distal half below the genitalia. In the middle of its course each radial canal gives out a number of alternating pinnated branches, twenty to thirty on each side, at right angles at the two edges (fig. 5). These branches are longest in the middle (up to 10 mm.), and gradually decrease in size towards the ends of the radial canal; they are very short at both ends. The genitalia proceed from their lower wall. The four genital glands (figs. 5, 6) seen from the subumbrellar surface have the shape of broad elliptical or almost circular leaves, occupying the centre of the radial canals from which they hang freely into the umbrella cavity (figs. 1, 2). On closer inspection it is shown that each gland forms a delicately-pinnated leaf, whose 20 to 30 pairs of pinnated branches are lamellæ placed perpendicularly (*s*). The upper edge of each lamella is connected with a transverse pinnated branch of the radial vessel, whose lower (subumbral) wall forms a fold; the lower free edge of each lamella is serrated or rather, split up into a number of finger-shaped points. The number of these points is greatest (10 to 15) in the broadest lamellæ in the middle of each gland, smallest in the narrowest lamellæ at the two ends of the genitalia. Each lamella is therefore, in itself the half of a pinnated leaf, whose straight upper edge has grown to the transverse branch of the radial canal, whilst the divided lower edge projects freely into the umbrella cavity.

Order III. TRACHOMEDUSÆ, Hæckel, 1866.

Craspedotæ with auditory clubs, which sometimes stand freely on the umbrella margin, and are sometimes enclosed in auditory vesicles, with endodermal otolite cells. Ocelli at the basis of the tentacles usually wanting. Genitalia always in the course of the radial canals. Number of the radial canals, sometimes four, sometimes six, sometimes eight, never more; between these there are often centripetal blind canals. The velum is firm and broad. Ontogenesis, so far as we yet know, hypogenesis (or direct development without alternation of generations) usually accompanied by metamorphosis.

Family, TRACHYNEMIDÆ, Gegenbaur, 1856.

TRACHYNEMIDÆ, Hæckel, System der Medusen, 1879, p. 255, taf. xvii.

Trachomedusæ with eight radial canals, along whose course the eight genitalia lie; with long tube-like stomach without ventral peduncle; with auditory clubs, which are seldom free but usually enclosed in auditory vesicles lying on the umbrella margin.

Sub-family, PECTYLLIDÆ, Hæckel, 1877.

Trachynemida with sucking cups on the tentacles, with radial mesogonia or broad mesenterial bands.

Pectyllis,[1] Hæckel, 1879.

Trachynemidæ with eight genitalia in the course of the eight radial canals, without centripetal canals. The genitalia are cut in two by eight radial mesogonia or leaf-shaped mesenterial bands, and connected with the bases of the stomach. Oral cavity without oral funnels, and without side pouches. Tentacles with sucking-cups very numerous and placed closely one over the other in several rows on the umbrella margin. Numerous (8 or 16 ?) auditory clubs.

The genus *Pectyllis*, with the two following genera *Pectis* and *Pectanthis*, form the special small group of the Pectyllidæ, which I placed in the System der Medusen (1879, p. 265) as a sub-family in the family of the Trachynemidæ. The Pectyllidæ are, however, so strongly distinguished by several striking peculiarities from the remaining Trachynemidæ, the Marmanemidæ, that it is better to separate them as a special family. The Pectyllidæ agree with the Marmanemidæ in having eight radial canals and eight genitalia hanging from them, in the form of the depressed umbrella, and in the absence of a gelatinous gastral peduncle; on the other hand, they are distinguished from them by two peculiar characteristics which are wanting in the other Trachomedusæ, in having eight mesogonia and numerous sucking-tentacles furnished with terminal sucking-cups. The auditory clubs of the umbrella margin are free as in the Aglauridæ, not enclosed in "marginal vesicles" as in the Marmanemidæ. The peculiar "mesogonia," or genital mesenteries, are thin, membranous, vertically-placed leaves, which extend in the radial plane between the central œsophagus on the one side and the eight sac-shaped reproductive glands on the other, are inserted in the middle line of the latter, and sometimes pass along the radial canals almost to the umbrella margin. The upper part of the umbrella cavity is, therefore, divided into eight radial sections ("infundibula subumbralia"). The peculiar sucking tentacles of the Pectyllidæ are hollow or solid, very elastic and contractile threads, which bear a powerful sucking-cup at the free end, and are used for adhering by suction. Part of them resemble the "ambulacral-feet" of the echinoderms in form and in the mode of motion. The sucking tentacles are very numerous in all three genera of the Pectyllidæ, sometimes closely packed together in several rows, one above the other, on the margin of the umbrella; sometimes grouped more or less distinctly in separate bunches; in all of them we can distinguish sixteen (or 32 to 64) bunches more or less divided by marginal incisions, so that the umbrella margin appears almost lobed. A further peculiarity of the Pectyllidæ is the extremely broad, powerful velum, which apparently, in all three genera, can be extended till, like a sphincter, it completely closes the umbrella cavity; they surpass all other Craspedotæ in this extreme development of the velum. The Pectyllidæ are finally distinguished by a peculiar formation of the circular canal, namely the glandular folds or tufts of its endoderm lining, which project from its lower edge into the lumen of the vessel. As all the three genera of the Pectyllidæ which have been observed as yet (each only with one species) are typical deep-sea Medusæ, it is probable that the special peculiarities above mentioned are partially or entirely the result of adaptation to life at great depths of the sea. At any rate they are of sufficient importance to justify the separation of the Pectyllidæ from the Marmanemidæ as a special family. Among the three genera of the Pectyllidæ, *Pectanthis* is distinguished by the sucking tentacles being grouped in sixteen separate bunches, whilst in the other two genera they are closely crowded together along the edge of the umbrella margin. *Pectis* is characterised by having blind centripetal canals which are wanting in *Pectyllis* and *Pectanthis.*

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[1] Πηκτύλλις, *Pectyllis*, derivative of *Pectis*.

Pectyllis arctica, Hæckel (Pls. III., IV.).

Pectyllis arctica, Hæckel, 1879, System der Medusen, p. 266, No. 287.

Umbrella nearly hemispherical, about 1½ times as broad as high. Exumbrella with sixteen projecting radial ribs, alternating with sixteen deep radial grooves. Stomach quadrangular prismatic, about as long as the radius of the umbrella. The margin of the mouth fleshy and thickened, quadrate, with four perradial pointed lobes and four interradial strong longitudinal muscles. Eight egg-shaped genitalia in the proximal half of the radial canal, divided in two by broad radial mesogonia. Border of the umbrella thickened, thickly beset with several rows of sucking-cups, which are divided into sixteen larger and forty-eight smaller groups (16 to 20 sucking-cups in each group). Between these are placed sixteen longer and thirty-two shorter tentacles, and numerous (?) (8 to 16) auditory clubs. Horizontal diameter of the umbrella, 18–24 mm.; vertical diameter, 12–16 mm.

Habitat.—Arctic part of the North Atlantic Ocean.

I had an opportunity of examining several well-preserved spirit-specimens of this species from the Copenhagen Zoological Museum, which were collected by Olrik in 1868 on the west coast of Greenland. A specimen from Station 50 of the Challenger list (dredged 21st of May 1873, near Halifax, at a depth of 1250 fathoms; lat. 42° 8′ N., long. 63° 39′ W.) is identical with them. The Pectyllid described by Allman in 1878 as *Ptychogastria polaris* (Nare's Narrative of a Voyage to the Polar Sea, vol. i. p. 299) appears closely related to this species. I saw an incomplete specimen of this in 1879, in the British Museum.

The umbrella (Pl. III. figs. 1, 2; Pl. IV. figs. 3, 4) is nearly hemispherical, so that the transverse diameter across the opening of the umbrella cavity is nearly twice as great as the vertical axis (fig. 1). The former measures 18–24 mm., the latter 12–16 mm. The gelatinous substance of the umbrella is thin but firm, and appears to be nearly of the same thickness throughout its whole extent (fig. 3). The exumbrella or the outer convex surface of the umbrella is divided by sixteen rim-like radial ribs whose distal ends project lobe-like on the margin of the umbrella, into sixteen deepened radial areæ or grooves (Pl. III. figs. 1, 2); eight of the sixteen radial ribs correspond with the underlying genitalia and mesogonia (four perradial and four interradial). The eight principal ribs unite above in the centre of the exumbrella into an eight-rayed star, while the eight remaining adradial ribs which alternate with these do not reach the top of the umbrella. Each two ribs are united at the distal end by a two-limbed clamp; whose intercostal centre turns inwards and downwards (figs. 1, 2). This arching inwards forms the boundary between each two of the sixteen flat marginal lobes, and lies in the ideal prolongation of the sixteen intercostal radial grooves of the exumbrella ("sulci exumbrales"). These form the deepest part of the concave grooves between each two ribs. They are only sharply defined in the middle zone of the exumbrella, and obliterated below and above. A very delicate radial rib runs in the exumbrella between each groove and each rib (fig. 1).

The umbrella margin ("margo umbralis," figs. 1, 2, 4, 10, &c.) is considerably thickened, and even at a superficial view appears divided, more or less clearly, into sixteen flat, slightly convex, projecting lobes, each of whose central points forms the distal end of a radial exumbral rib. The entire margin of the umbrella is continuously beset with numerous tentacles (above a thousand), which are placed one over the other in several rows, and are transformed into short-stalked sucking-cups. Isolated auditory clubs (8 or 16 ?) are placed between them. A very broad velum projects inwards from the ring of cnidæ of the umbrella margin.

The number of marginal tentacles amounts to 1000 or 1200; all bear a terminal sucking-cup. Only a small number of them appear in the form of longer or shorter filaments; in the greater number the filaments part of the tentacle is so much reduced, and the terminal sucking-cup so strongly developed, that they appear as short-stalked or even unstalked suckers ("acetabula"). The distribution of these appendages is very regular and peculiar. Each of the sixteen marginal lobes bears a principal group, composed of three larger sucking-cups and three triangular sucking-plates alternating with them, and in each sucking-plate we can distinguish sixteen to twenty sucking-cups of different sizes (comp. figs. 1, 2, 4, 10). Sixteen very large sucking-cups of the first size are the keystones of the arches, at the end of the sixteen exumbral ribs (fig. 7, *xa*; fig. 10, A). Thirty-two sucking-cups of the second size lie somewhat depressed between them (fig. 8, *xb*; fig. 10, B). Between these two series placed still deeper and with longer stalks there are forty-eight sucking-cups of the third size (fig. 5, *xc*; fig. 10, C). Finally, under these, closely crowded together in a triangular group, are numerous smaller sucking-cups with longer stalks, their number increasing towards the insertion of the velum, while their size diminishes (fig. 6, *xd*). Each of these so-formed "sucking-plates" has a great resemblance to the sucking-plates at the end of the two long prehensile arms of the ten-armed Cephalopods (*Sepia*, &c.). It was not so easy, unfortunately, to determine the number of the longer tentacles with a small sucking-cup at the end, as most of these had been torn away. It appears, however, that sixteen longer tentacles (hardly as long as the radius of the umbrella) are inserted under the sixteen uppermost sucking-cups of the first size, and thirty-two shorter tentacles between them below the sucking-cups of the second size (figs. 1, 2). The structure of these tentacular formations is the same everywhere. The principal mass forms a strong, solid axis of large chordal cells (or clear vesicle-like endoderm-cells, *yt*). This is covered by a thin but firm and very elastic fulcral plate, and above this a thin layer of longitudinal muscular fibres. The external epithelium of the ectoderm covering the latter is rich in cnidæ, which are usually accumulated on the abaxial side of the tentacle basis in the form of a thick cushion of cnidæ (figs. 6, *n*; 8, *n*). The sucking-cup at the truncated end of the tentacles is likewise furnished on its enlarged margin with a thick ring of cnidæ, and has a strong muscular plate on its concave surface (fig. 7, *xa*). The mode in which these sucking-cups are very regularly and delicately distributed on the margin of the umbrella will be best understood by comparison of figs. 1 and 2 in Plate III., figs. 4 and 10 in Plate IV. and of the sections of the umbrella margin in figs. 5–8 (comp. the explanation of Pls. III. and IV.). The velum (figs. 2, 3,*v*; 4,*v*), is very broad and powerful, and appears capable of completely closing the umbrella cavity. The internal axial half, whose free margin surrounds the narrow entrance to the umbrella cavity, is much thinner than the strong external or abaxial half; the two halves are divided by a deep annular fold projecting into the umbrella cavity (figs. 3, 4). The muscles of the velum form numerous delicate circular folds. The subumbrella has also very strong circular muscles forming numerous ring-like folds on the whole lower surface of the umbrella. The umbrella cavity is divided (as in *Pectanthis asteroides*) into eight deep funnel-like sections, as eight broad, vertical septa (four perradial and four interradial) stretch across from the eight radial canals and genitalia to the base of the stomach (mesogonia, fig. 3, *wa*).

The central mouth leads into a tube-shaped quadrangular stomach, from whose basis in the bottom of the umbrella eight radial canals pass out (four perradial and four interradial). These bear the sac-shaped genitalia in their proximal half, which are fastened to the subumbrella by the leaf-shaped mesogonia just mentioned. The stomach is a very thick-walled tube with strong muscles, has the form of a quadrate pyramid, is fixed by the narrow basis in the centre of the subumbrella, and hangs down in it nearly to the middle of the height of the umbrella cavity (fig. 3, *gp*). At the quadrate oral opening the four perradial corners of the pyramid (*ak*) pass into four triangular oral lobes (*al*) whose axial internal surface is divided by a (perradial) longitudinal groove into two lips (fig. 2). An interradial thickening of the longitudinal muscle appears sharply defined between each two oral lobes (figs. 2–11). The interradial oral edges which are divided in two by the longitudinal muscles are turned over outside (like the brim of a hat). The very powerful muscles of the mouth and of the stomach lie in numerous folds projecting internally (figs. 2, 12).

The eight narrow radial canals (fig. 3, *cr*) which run at equal distances from the fundus of the stomach (fig. 3, *go*) to the periphery, are there opened into a narrow annular canal (fig. 3, *cc*; figs. 5–8, *cc*). In the transverse section these walls show numerous thick folds and tufts (*dp*), which proceed from the distal margin of the canal, and project freely into its lumen. As usual, the outer or umbral wall of the annular canal, which lies close to the marginal portion of the gelatinous substance of the umbrella (*n*), is covered by a flat, tabular epithelium (*dn*), whilst, on the other hand, the remaining portion or the subumbral wall is covered by high, cylindrical epithelium (*dw*). The latter also lines the tufts or folds of the lower wall of the canal. At their basal end (which is turned from the lumen of the canal), the very high cylindrical cells of the tufts contain granules of black pigment, enclosing a nucleus. These pigmented tufts (which resemble the intestinal tufts of the vertebrata) have probably secretive or excretive functions. (Comp. Pl. IV. figs. 5–8, and explanation.)

The eight genitalia or reproductive glands (figs. 2–3, *sc*) hang in the proximal halves of the eight radial canals, as visible sacculations from it (four perradial and four interradial). These appear as wide, fluted, thick-walled, egg-shaped, or fusiform sacs. A radial mesogonium (or genital mesentery) rises in the middle of the subumbral wall of each sac, as a thick vertical fold of the subumbrella, which passes from the basis of the stomach to the umbrella margin (fig. 3, *wr*). These eight mesogonia attach the corners of the stomach, halve the eight genitalia, and divide the space of the umbrella cavity into the eight above-mentioned umbrella funnels, or the peripheric niches of the umbrella cavity.

Pectis,[1] Hæckel, 1879.

Trachynemidæ with eight genitalia in the course of the eight radial canals, between which blind centripetal canals run from the annular canal. Genitalia connected with the basis of the stomach by eight radial mesogonia or leaf-shaped mesenterial bands. Oral cavity with eight invaginated oral funnels, and sixteen evaginated side pouches. Tentacles with sucking-cups very numerous, closely crowded together in several rows above each other on the umbrella margin. Numerous (8 or 16 ?) auditory clubs.

The genus *Pectis* is strikingly distinguished from both other genera of Pectyllidæ by its blind centripetal canals, which run out in large numbers from the annular canal (as in *Olindias* among Petasidæ, *Glossoconus* and *Glossocodon* among the Liriopidæ, *Carmaris* and *Carmarina* among the Carmarinidæ). The sucking-tentacles beset the whole umbrella margin, closely crowded in several rows over each other, as in *Pectyllis*, not in separate bunches as in *Pectanthis*. The radial mesogonia are much less strongly developed than in the two other genera. The structure of the œsophagus, with its eight curious adradial, ectodermal, oral funnel cavities, and the eight pair of endodermal side pouches alternating with them, is quite peculiar, and, as far as I know, does not exist in any other Craspedota.

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[1] Πηκτις, hardened, stiffened.

Pectis antarctica, Hæckel (Pls. V., VI.).

Pectis antarctica, Hæckel, 1879, System der Medusen, p. 266, No. 288.

Umbrella almost hemispherical; about 1½ times as broad as high. Exumbrella finely radially ribbed, with thirty-two more prominent ribs towards the margin. Stomach quadrangularly prismatic, nearly as long as the radius of the umbrella. Oral cavity with eight pairs of hemispherical side pouches. Oral margin fleshy and thickened, quadrate, with four radial oral tentacles. Eight genitalia, egg-shaped sacs having folds, in the proximal half of the radial canals, connected with the base of the stomach by eight narrow radial mesogonia. 11 to 13 blind radial canals (3 larger and 8 to 10 smaller) between each two radial canals. Umbrella margin, thickened into a roll; thickly beset with numerous rows of sucking-cups (about a thousand), forming thirty-two connected groups. Between these numerous (8 to 16 ?) free auditory clubs. Horizontal diameter of the umbrella, 36 mm.; vertical diameter, 24 mm.

Habitat.—Antarctic portion of the Indian Ocean, S.S.E. from Kerguelen Island. Lat. 60° 52′ S., long. 80° 20′ E. Depth, 1260 fathoms. Station 152. 11th February 1874. From this habitat I had only one single specimen for examination, but it was complete and well preserved.

The umbrella showed, in a perfectly uninjured state, the peculiar natural shape represented in figs. 1 and 2, Plate V.; fig. 11, Plate VI. A deep exumbral circular furrow runs externally round the umbrella, about half-way up its height, dividing it into an upper, nearly hemispherical, umbrella cone, and a lower, shallow, funnel-shaped, umbrella margin. The largest transverse diameter of the umbrella (at the opening of the umbrella-cavity) amounted to 36–40 mm., and was nearly double that of the largest vertical diameter (in the axis of the umbrella).

The exumbrella (or the external, convex surface of the umbrella) is traversed throughout by a very large number of fine radial ribs, amounting in the periphery of the umbrella to 500 to 600 (Pl. V. fig. 1; Pl. VI. fig. 20). Besides these there are also thirty-two more prominent radial ribs, running the whole length, and thirty-two less prominent "costæ exumbrales" (fig. 20, *cs*) alternating with them.

The gelatinous substance of the umbrella (fig. 2, *ug*) is nearly of equal thickness in the upper aboral half of the umbrella, and nearly as thick on the radial section as the genitalia fixed on its subumbral side. It is very much thickened in the centre of the apex, and projects into the fundus of the gastral cavity in the form of a short, conical, gelatinous appendage (fig. 2, *nk*). On the other hand, the gelatinous substance is much thinner in the lower oral half, hardly one-fourth or one-fifth as thick as in the upper half, from which it is sharply divided (half-way up the height of the umbrella) by the exumbral circular furrow. An enormous number of sinous elastic fibres, running from the exumbral to the subumbral wall, traverse the gelatinous substance of the umbrella, to which they give a considerable degree of firmness; they are placed together in dainty pyramids (fig. 8, *uf*), whose points touch the exumbrella (*e*), and their bases the subumbrella (*w*); these pyramids form regular longitudinal series, corresponding to the exumbral radial ribs.

The umbrella margin ("margo umbralis," figs. 1, 11, 12, 20) is not so visibly lobed in this genus of the Pectyllidæ as in the two others, but rather appears to be of equal thickness all over, and closely beset with an enormous number of short sucking-tentacles placed in several rows above each other. Closer consideration, however, shows that this garniture of the umbrella margin is by no means equally distributed, but rather arranged in eight larger and thirty-two smaller groups. These, however, hang closely together, and are not separated by depressions as in *Pectyllis* and *Pectanthis*. A similar lobed formation of the umbrella margin also exists fundamentally in *Pectis*, though it is not so apparent externally as in the other two genera. Each of the thirty-two small groups of tentacles (fig. 20, *td*) consists of from 30 to 40 solid tentacular appendages. Of these the 16 to 20 upper (proximal) are short-stalked, pyriform, or club-shaped sucking-cups, the 12 to 16 lower (distal) on the contrary are somewhat longer tentacles, partly with a terminal sucking-cup, partly apparently forming feelers. These "tactile tentacles" without sucking-cup (fig. 17) were mostly torn away, the longest barely above 1 mm. in length. They are probably much longer in the living animal (as in *Pectyllis arctica*, Pl. III. fig. 1). The numerous sucking-cups form 6 to 8 alternating rows placed one above the other on the umbrella margin; in each of the thirty-two small groups, which have an almost rhomboidal outline, they are placed in 5 to 6 diagonal rows, each with 4 to 5 tentacles (fig. 20). The size of the sucking-cups, which enclose a visible conical ectodermal sucking cavity, decreases gradually from above downwards (fig. 12). A larger sucking-cup is placed above somewhat further on the umbrella margin (fig. 20, *st*). All the tentacles of this genus are solid; their endodermal axis consists of large clear chordal cells which are sometimes placed in a discoid row one behind the other (fig. 17, *dt*), sometimes more numerous and in a more complete arrangement beside each other (fig. 15, *dt*). This vesicular axial tissue is covered by very powerful internal annular muscles, which thicken at the end into a strong annular swelling; single bundles of external longitudinal muscles, very much thickened at the exumbral side of the tentacles, extend out above these annular muscles; they run out below the sucking-cups into eight to twelve radial cords, which converge towards the centre of the sucking-cup (figs. 9, 10).

The auditory clubs (probably eight or sixteen) lie on the axial side of the umbrella margin, under the insertion of the velum, inside the lowest row of tentacles. After most careful search, I was only able to discover two or three of them, very small, and of the same construction as in the Aglauridæ. The thin endodermal axis of the auditory club (fig. 16) consists of a few chordal cells (*d*), of which the last is expanded like a vesicle, and contains a large spheroidal otolith with concentric layers (*ol*). The ectodermal cells of the epithelium of the club bear very long and fine auditory hairs (*oh*).

The velum (figs. 11–14) is thicker in *Pectis* than in any Craspedote hitherto known, and is distinguished by a very unusual development of the muscular system. The breadth of the velum is so great that when fully extended it can probably close the entire umbrella cavity like a sphincter. The external abaxial half of the velum contiguous to the umbrella margin, is nearly as thick as the tentacles, and three to six times as thick as the internal axial half, from which it is divided by a deep circular furrow (fig. 11, right half). If we draw the free projecting internal margin of the velum carefully towards the inside, we can bring it so near the centre as to make it probable that the umbrella cavity can be completely closed by the velum being drawn over it, as in the foregoing species. The following layers (from above to below in the natural position of the horizontal extended velum) can be distinguished in horizontal sections through the velum :—(1) the ventral or subumbral epithelium of the velum (*vw*), containing dark-brown pigment similar to that of the subumbral epithelium; (2) a considerably thick layer of clear vesicular connective tissue (*x*); (3) the muscular plate of the velum which projects into this connective tissue in the form of numerous highly-developed circular folds, each fold sending out numerous secondary folds or shoots into the clear plate of connective substance (*x*), so that it appears delicately pinnated in the transverse section (fig. 13, *mv*) ; (4) a thin but firm elastic supporting lamella, which sends out processes into the muscular folds (*zv*); (5) the dorsal or exumbral epithelium of the velum (*ve*). The epithelial cells of the exumbral epithelium of the velum are much smaller and flatter than those of the subumbral.

The ectodermal epithelium of the lower surface of the umbrella or the subumbrella consists of cells of dark brown pigment, from which the milk-white walls of the canals are sharply thrown out. The underlying annular system of the subumbrella forms numerous compact circular folds. In *Pectis* the umbrella cavity is simple, without subumbral funnel cavities, as the eight radial "mesogonia" or "genital mesenteries" so strongly developed in *Pectyllis* and *Pectanthis* are by no means so complete here. They are merely indicated by eight narrow subumbral folds, running from the basis of the eight genitalia to the basis of the stomach (fig. 2, *wr*).

The gastrovascular system in *Pectis* has, on the whole, the same plan as that of

Pectyllis, but is easily distinguished by the blind centripetal canals running from the circular canal, and also by the peculiar side pouches in the periphery of the mouth, and the oral funnels alternating with these (Pl. V. figs. 2–5; Pl. VI. fig. 11). The central œsophagus hangs down from the fundus of the umbrella cavity till past the middle of it in the shape of a quadrangular tube beset above the oral opening with eight pairs of side pouches. The eight radial canals running out from the basis of the stomach unite at the umbrella margin into a circular canal, from which run numerous short blind centripetal canals (Pl. VI. fig. 11).

The quadrate oral opening (figs. 3, 4, *al*; fig. 11 in the middle) is surrounded by a very muscular protuberant oral margin, whose surface has strong folds of the circular muscle (fig. 3, *me*). These folds are divided into four interradial groups by four perradial longitudinal muscles, ending in the four short heart-shaped oral lobes (fig. 3, *al*). Above this muscular oral margin (which is probably very ductile, and adapted for adhesion by suction) appears a very prominent circle of sixteen side pouches ("bursæ buccales," figs. 2–5, *bb*). These form hemispherical, or, more properly, semioval evaginations of the gastral wall, and hang together in pairs in such a way that eight pairs appear as oral bifurcated terminal shoots of the eight gastral grooves (*gs*); of these longitudinal grooves of internal wall of the stomach, which proceed above in the fundus of the gastral cavity (figs. 3, 4, *cr*). Each two pairs of side pouches are divided by a peg-shaped oral funnel (infundibulum orale, figs. 2, 4, 5, 10). These conical adradial oral funnels are quite peculiar invaginations of the gastral wall, in a certain measure "internal side pouches" unknown to me in any other Medusa. Their conical cavity, which is cœcal at the point, is lined by the ectoderm, and opens into the umbrella cavity, whilst these "external side pouches" (*bb*) are lined by the endoderm, and open into the oral cavity. Such "external side pouches" are unknown to me in any other Craspedota, but they occur in the Periphyllidæ among the Acraspeda (compare below). The ectodermal external wall of the external side pouches is coloured with violet-brown pigment, and has a broad milk-white dentated longitudinal striation in the middle. The endodermal covering of the oral funnels is coloured milk-white, and sharply contrasted with the dark violet periphery of the oral cavity. The upper part of the gastral cavity into which the gelatinous sphere of the umbrella (fig. 2, *ubr*) projects, appears eight-rayed in the transverse section (fig. 6), as eight adradial longitudinal folds running from the eight oral cavities project inwardly between the eight concave gastral groups into the lumen of the central cavity (*g*). Compare the perradial longitudinal section (fig. 4).

The eight radial canals (figs. 11, 20, *cr*) which run from the basis of the stomach to the umbrella margin, and there open into the circular canal, as well as the circular canal itself (*ce*), and the blind centripetal canals proceeding from it, are not cylindrical tubes, but flattened band-like vessels which are sharply distinguished by their milk-white colour from the dark violet subumbrella. In transverse section (fig. 12, *ce*) the circular canal shows a high circular fold projecting nearly half-way into the lumen at its lower marginal edge, which touches the basis of the velum (*yc*); the high cylindrical partly-pigmented epithelium of this fold has probably a glandular nature like the similar folds and tufts in the annular canal of *Pectyllis*.

Pectis is specially distinguished by the blind centripetal canals proceeding from the annular canal, as these are wanting in the closely-related genera *Pectyllis* and *Pectanthis*, although they are indicated in the latter by the eight adradial projections of the circular canal, which alternate with the eight radial canals (Pl. VII. figs. 11, 20, *ce*). On the whole, the centripetal canals of *Pectis* comport themselves like those of *Olindias* among the Petasidæ, and of *Glossoconus* and *Carmarina* among the Geryonidæ, but they are shorter and broader, and have the form of a pointed equilateral triangle (fig. 20, *ce*). Their aggregate number amounts to 80 to 100, as 11 to 13 centripetal canals lie between each two radial canals, with the starting-point of their broad basis touching the circular canal. Although their number and arrangement is not perfectly regular, the (primary) adradial centripetal canal (in the middle between each two traversing radial canals) is always the largest. Then follow the (secondary) centripetal canals, which lie in the middle between the former and the latter, whilst the remaining canals are considerably smaller and irregularly distributed (comp. Pl. VI. figs. 11 and 20; Pl. V. fig. 2).

The eight genitalia (Pl. V. fig. 2, *bs*; Pl. VI. fig. 11) in *Pectis* as in *Pectyllis* (Pl. IV. fig. 3) are wide, folded, thick-walled pouches, which occupy the proximal half of the radial canals and communicate with the lumen of the eight radial canals by a wide fissure. The eight mesogonia or "genital mesenteries," which connect the genitalia with the aboral half of the œsophagus, as broad radial lamellæ in *Pectyllis* and *Pectanthis*, are rudimentary in *Pectis* (fig. 2, *wr*). In the only specimen examined (a female) the wide cavity of the reproductive pouch was empty for the most part, and only contained a few ova.

Pectanthis,[1] Hæckel, 1879.

Trachynemidæ with eight genitalia in the course of the eight radial canals, without centripetal canals. Genitalia halved by eight radial mesogonia or leaf-shaped mesenterial bands, and connected with the base of the stomach. Oral cavity without oral funnels and without side pouches. Tentacles with sucking-cups very numerous, divided into sixteen separate bunches, each two bunches between two radial canals; sixteen subradial auditory clubs, one in the middle of each bunch of tentacles.

The genus *Pectanthis* is distinguished from the two other known Pectyllidæ from the numerous tentacles being divided into sixteen isolated subradial bunches, so that each bunch lies in the middle between a radial canal and an intercanalar adradial rib of the exumbrella. A free auditory club is placed in the centre of each bunch upon a projection on the lower side of the umbrella margin. The margin of the umbrella appears distinctly divided by sixteen incisions (four perradial, four interradial, and four adradial), into sixteen projecting lobes, each bearing a bunch of tentacles with an auditory club. The eight mesogonia by which the umbrella cavity is divided into eight funnels are strongly developed, as in *Pectyllis*, and the numerous cæcal centripetal canals between the radial canals, by which *Pectis* is distinguished, are also wanting as in *Pectyllis*.

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[1] Πηκτις, firm, compact; ἄνθος, a flower.

Pectanthis asteroides, Hæckel (Pls. VII., VIII.).

Pectanthis asteroides, Hæckel, System der Medusen, p. 267, No. 289.

Umbrella depressed to a hemisphere; two to four times as broad as high. Exumbrella with sixteen radial ribs. Stomach quadrangularly prismatic; nearly as long as the radius of the umbrella. Mouth four-lobed, extensible into an octagonal sucking-disk. Eight egg-shaped genitalia in the proximal half of the radial canal, encircling the basis of the stomach in the form of an eight-rayed star, and halved by long radial mesogonia. Umbrella margin swollen, thickened, with sixteen intercostal protuberances or marginal lobes, each bearing a subradial auditory club and a pencil-shaped tuft of twelve to sixteen tentacles. Tentacles hollow, of unequal length, the longest equal to the radius of the umbrella, generally with a sucking-disk at the end. Horizontal diameter, 5 mm.; vertical diameter, 2 mm.

Habitat.—The Mediterranean. I myself caught a living specimen of this deep-sea Trachomedusa with the tow-net in the Adriatic Sea on April 15, 1878, at a depth of 200 fathoms, some miles distant from Pola. The following description and the figures on Plates VII. and VIII. are prepared from this specimen (a mature male), which was examined alive. I also found a small specimen of the same species, which did not admit of any minute investigation, but still furnished proof of its identity in a bottom specimen from the Challenger collection from Station 4, at the entrance of the Straits of Gibraltar. Lat. 36° 25′ N., long. 8° 12′ W. 16th January 1873. Depth, 600 fathoms.

In the example which I observed alive in Pola, the umbrella in a contracted condition had an almost hemispherical bell shape. In a dilated condition, on the other hand, it appeared distinctly depressed, so that the largest horizontal diameter was three to four times greater than the largest vertical diameter. The former measured 4–5 mm., the latter 1–2 mm.

The exumbrella or the external convex surface of the umbrella is divided by sixteen projecting radial-ribs into sixteen deepened radial areæ or depressions, which project like lobes on the umbrella margin (Pl. VII. fig. 12). Of the sixteen radial ribs ("costæ exumbrales"), four perradial and four interradial (in the middle between the former) lie above the mesogonia. These eight principal ribs are distinguished by thin streaks of purple-red pigment, which pass into eight large red ocellar spots at the umbrella margin, but are wanting in the eight other alternating adradial ribs. All sixteen ribs are tipped with nematocysts, which appear yellowish-white by reflected light and black by transmitted light. These spots of pigment form a broad band in the periphery of the exumbrella above the margin of the umbrella, and are divided from it by a colourless streak. The eight red ocellar egg-shaped spots before mentioned are placed at the distal ends of the eight red pigmented ribs; they may, perhaps, be considered as true ocelli, though they do not appear to contain a lens (comp. Pl. VII. fig. 1). Besides these, there are also sixteen large crescent-shaped golden-yellow spots at the marginal end of the ribs of the exumbrella. The sixteen concave intercostal radial depressions of the exumbrella alternating with these increase in breadth and depth towards the umbrella margin, and are traversed in the middle by a deep-radial furrow ("sulcus exumbralis"). A pedunculated subradial auditory club lies at the end of these radial depressions (Pl. VIII. fig. 8, *ok*) in the middle of the projecting marginal lobe, and of the bunch of tentacles borne by it.

The peculiar peripheric umbrella margin ("margo umbralis," Pl. VIII. fig. 8) is considerably thickened, and armed with a connected urticating ring (*nc*), consisting of a thick accumulation of thread-cells. The sixteen protuberances or flat lobes are rounded like an arch, and when looked at from above (and also at their subumbral surface) show a cord of cilia pigmented black immediately inside the urticating ring. This ciliated cord is sinous, and forms from eight to ten projecting vessels on each lobe (fig. 8, *xp*). In the arching inwards of the umbrella margin between each two lobes, at the distal end therefore of each exumbral rib, the black ciliated cord becomes a tongue-shaped projection, showing a funnel-like depression, which may perhaps be an organ of smell (fig. 8, *xo*). A small free auditory club rises on the outer edge of each of the sixteen marginal lobes enclosing a spheroid or elliptic otolite in the free end (in the last endodermal cell, fig. 8, *ok*). The auditory club lies nearer the lower margin of the umbrella, inwards from the insertion of the tentacles. More minute investigation was unfortunately impossible.

The tentacles, which amount to 200 to 260, are divided into sixteen pencil-shaped bunches, each two bunches between each two radial canals. In the transverse section the tentacles are hollow (fig. 4), capable of great extension, movable and contractile, furnished with a sucking-disk at the end, and are very similar to the ambulacral feet of the Echinodermata. The Medusæ attach themselves by these sucking-disks to the vertical walls of the glass vessel, and climb up them like an Asterias or a Sea-urchin (figs. 6, 10). The living specimen which I observed at Pola assumed moreover the peculiar attitude represented in Plate VIII. fig. 7. The Medusa lies on its back, extends a portion of the sucking-feet stiffly out round it, and attaches itself to the bottom of the glass, whilst the other portion of the sucking-feet play freely in the water, as if feeling and fishing for prey; the mouth, therefore, stretches vertically from the opening of the velum, which is contracted like a funnel, and also moves as if groping in different directions. The tentacles, when extended, are almost as long as the radius of the umbrella; when contracted they are much shorter; in the centre they are thickened like a spindle, and become thinner at either end. A more minute investigation of the tentacles shows that we can distinguish two different forms. The larger number have a sucking-disk, which is pigmented red at the end, and are used for crawling and adhesion by suction; the smaller numbers are simply pointed at the end, without sucking-disk, and are used as feelers, usually extended round and upwards, and moving like worms (figs. 6–10).

The velum (fig. 3, *vn*; fig. 7) is very thick, broad, and powerful. The plate of its circular muscles is arranged in numerous circular folds projecting from the subumbral surface, which, by interference, produce an iridescence. It is probable that in *Pectanthis* (as in *Pectis* and *Pectyllis*) the velum can be extended so as to entirely close the umbrella cavity like a sphincter. The circular muscles of the subumbrella form projecting circular folds similar to those of the velum, but are arranged in sixteen arcades corresponding to the sixteen exumbral ribs and to the sections of the umbrella margin between every second lobe (fig. 9, *wn*). The subumbral exoderm is distinguished by scattered nematocysts (fig. 9, *wn*). The umbrella cavity is divided, as in *Pectyllis arctica*, into eight separate compartments, or funnel cavities, as the eight broad leaf-shaped mesogonia (fig. 9, *wr*) are stretched between the radial canals and the basis of the stomach (see below).

The central four-lobed oral opening leads into a tube-shaped four-sided stomach, from whose basis eight radial canals (four perradial and four interradial) run out in the bottom of the umbrella cavity. These bear the eight genitalia as sack-shaped evaginations in their proximal half, and are united in the umbrella margin by a circular canal which sends out branches into the tentacles. The central œsophagus (fig. 9, *gb*) hangs down in the middle of the umbrella cavity as a muscular tube of a gold-yellow colour, and prismatic quadrate form. The four interradial lateral surfaces are slightly depressed into a groove between the four rounded perradial bodies. The œsophagus is nearly as long as the radius of the umbrella when extended, much shorter when contracted. The oral opening is divided by four shallow grooves into four short blunt oral lobes (*al*) armed with an accumulation of nemocysts. The mouth can project out of the umbrella cavity through the opening of the velum, and extend externally in the form of a very thin flat octagonal sucking-disk (fig. 3, *am*).

In a more extended condition the extremely thin oral disk extends almost to the margin, and shows eight small triangular lappets (four perradial and four interradial, fig. 3, *am*) at the margin of the mouth. Eight narrow radial canals run from the periphery of the bottom of the stomach; these are united at the umbrella margin into a circular canal, and the eight genitalia placed in their proximal third.

The eight genitalia (four perradial and four interradial) are egg-shaped, thick-walled sacs, pigmented red, and with the side walls touching each other; they surround the basis of the stomach like an eight-rayed star (fig. 2, *s*; fig. 9, *s*). The sacs are half as long as the œsophagus, occupying the upper half of the umbrella cavity, and contain a large evagination of the radial canal (fig. 5, *sc*). A radial genital mesentery or mesogonium, a vertical radial fold with brown stains of the subumbrella, is inserted in the middle of the subumbral wall of each genitalium; this begins at the basis of the stomach and runs along the subumbral median line of the radial canals to the margin of the umbrella (fig. 9, *wr*). These eight mesogonial leaves fasten the edges of the stomach, halve the eight genitalia, and divide the space of the umbrella cavity into the eight peripheric niches (or imperfect funnel cavities) above mentioned. The transverse section of each genitalium shows that they actually consist of two completely separated halves, between which the basis of insertion of the mesogonial fold (*wr*) is intersected as a dividing septum. The living specimen examined by me in Pola was a male. The two sperm-sacs of each genitalium (*sm*) were divided by a strong fulcral plate (*z*) from the high cylindrical epithelium of the endoderm (*d*), and lay immediately under the endodermal epithelium, to which they owe their origin.

Order IV. NARCOMEDUSÆ, Hæckel, 1877.

Craspedotæ with auditory clubs, which always stand freely on the umbrella margin, with endodermal otolite cells. Ocelli at the basis of the tentacles usually wanting. Tentacles inserted dorsally, connected with the distant umbrella margin by peronia which divide it into a number of collar lobes. Genitalia originally in the lower or oral wall of the stomach, from which they often extend peripherically into the radial gastral pouches. Radial canals sometimes wanting, sometimes present, in which case they extend in the form of flat, radial, gastral pouches. Annular canal sometimes obliterated, but always divided by the radial peronia into a number of arched canals bordering the margin of the collar lobes. Number of the radial parts (tentacles, lobes, and pouches) indefinite and varying, rarely four, usually eight or more up to thirty-two. Ontogenesis, as far as we know, usually hypogenesis, often accompanied by metamorphosis.

Family CUNANTHIDÆ, Hæckel, 1877.

CUNANTHIDÆ, Hæckel, System der Medusen, 1879, p. 310, taf. xix. figs. 1–3, taf. xx. figs. 1–6.

Narcomedusæ with broad pouch-shaped radial canals or pernemal gastral pouches, which are sometimes simple, sometimes split each into two cæcal lobe pouches, but are always connected with the circular canal by double peronial canals, with otoporpæ (or clasps of the cordyli) at the basis of the auditory clubs.

Sub-family, CUNOCTONIDÆ, Hæckel, 1877.

Cunanthidæ, whose radial pouches bifurcate each into two cæcal lobe pouches.

Cunarcha,[1] Hæckel, 1879.

Cunanthidæ, with four perradial tentacles, inserted in the bifurcation of four perradial gastral pouches, which at the distal part are continued into four lobe pouches.

The genus *Cunarcha* is one of the simplest and oldest of all forms of the Narcomedusæ, and is immediately connected with *Cunantha*, the hypothetic originating genus of this order; like the latter it has only four tentacles and four alternating collar lobes, but is distinguished from it by the four perradial gastral pouches being continued at the distal end into two cæcal lobe-pouches; eight cæcal lobe pouches, therefore, lie in pairs between the four tentacles in the periphery of the umbrella collar. This genus forms thereby a very interesting phylogenetic transition between *Cunantha* and *Ægina*. By retrograde formation of the otoporpæ and the proximal part of the radial pouches it would be transformed into *Ægina*. The presence of lobe pouches is common to *Cunarcha*, and to the genera *Cunoctona* and *Cunissa;* they compose the special sub-family of the Cunoctonidæ, whilst the other sub-family of the Cunanthidæ, the Cunoctanthidæ, have simple radial pouches without lobe pouches (*Cunantha, Cunoctantha, Cunina*), System, p. 314.

Cunarcha æginoides, Hæckel (Pl. IX.).

Cunarcha æginoides, Hæckel, 1879, System der Medusen, p. 315, No. 329.

Umbrella cap-shaped, one and a half times as broad as high. Lens of the umbrella biconvex. Umbrella collar with four broad, oval lobes, as long as the radius of the lens. Mouth with long conical œsophagus; four gastral pouches very broad and short, deeply cleft into eight distal lobe pouches occupying the greater part of the collar lobes; four perradial tentacles longer than the diameter of the umbrella; twelve auditory clubs (three on each lobe), the middle auditory club twice as large as the two lateral. Horizontal diameter, 4 mm.; vertical diameter, 2 mm.

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[1] *Cunarcha*. Oldest form of Cunoctonidæ.

Habitat.—West Coast of Africa. I first observed a living specimen of these species off Lanzerote, one of the Canary Islands, in December 1866, and the figures of Plate IX. and the following description are taken from this specimen. Later I found a specimen in a glycerine preparation of the Challenger expedition, containing the beautiful Phæodaria *Cœlodendrum*, south of the Azores, west from the Canary Islands, lat. 32° 41′ N., long. 30° 6′ W. Depth, 1675 fathoms. This glycerine specimen from the Challenger collection was very imperfectly preserved, but sufficiently preserved to settle its identity with the living specimen found at the Canaries. It is, however, possible (or probable) that this Medusa does not belong to such a great depth, but was captured in shallower water in drawing up the lead.

The umbrella (Pl. IX. figs. 1–3) has the form of a flat cap, and is nearly once and a half as broad as high. When the broad velum hangs loose, the aggregate height of the umbrella (including the velum) nearly equals the greatest breadth (in the middle of the height). The umbrella is divided into two distinct anatomical portions, the upper "umbrella lens" and the lower "umbrella collar," by a deep horizontal circular furrow of the exumbrella, the coronal furrow (fig. 3, *ec*). The central umbrella lens or umbrella disk (fig. 3, *w*) is simply formed by the gelatinous body of the umbrella, and has the form of a thick biconvex lens with a rounded edge; its upper surface is covered with the flat exodermal epithelium of the exumbrella, and is somewhat more strongly vaulted than the lower gastral surface, which is covered by the endodermal epithelium of the stomach. The two surfaces are connected by numerous fine, sinuous elastic fibres which traverse the gelatinous substance perpendicularly (fig. 6, *uf;* fig. 7, *uf*). The consistence of the gelatinous substance is considerable, resembling that of a soft gelatinous cartilage. The umbrella collar ("umbrella edge" or shortly "collar"), as we shall term the portion of the umbrella lying underneath the insertion of the tentacles, has a very complicate structure as contrasted with the simple lens lying above it. It consists of a corona of four lobes arising from deep radial indentations or incisions of the umbrella margin, the peronial furrows. And these, again, are caused by the four tentacles having left their original position on the umbrella margin and having emigrated a little way into the exumbrella. I consider this peculiar centripetal change of position of the tentacles into the exumbrella, which is probably connected with their partial development into feelers, as the first "true cause" of the manifold and varying transformations, which the umbrella margin and the adjacent organs undergo in all Narcomedusæ. Originally the tentacles were placed immediately on the margin of the umbrella as in the other Craspedotæ. When they passed upwards into the external surface of the umbrella, they took with them an urticating streak of the urticating ring of the margin, and this urticating streak becomes the umbrella clasp or "mantel clasp" ("peronium") (figs. 3, 4, *en*). This contains the basis of the tentacles in continuous connection with the urticating ring of the umbrella margin, and so gives rise to a radial furrow, more or less deep, of the umbrella collar which cuts through its gelatinous substance, but leaves the subumbrella intact. Transverse sections show that the peronia are tolerably thick, solid, clasp-like cords, consisting of a peculiar modification of urticating tissue; numerous strata of large spheroidal nematocysts lie closely accumulated one above the other. The distal end of the umbrella clasp is in continuous connection with the urticating ring of the umbrella margin (fig. 4, *nc*), whilst its proximal end is inserted at the spot where the tentacle (*t*) runs out from its conical root (*tr*). The exumbral surface of each peronium lies freely in the depth of the peronial furrow (between each two collar lobes), whilst its subumbral surface is covered by the longitudinal muscle (fig. 5, *mp*) which rises from the margin of the umbrella to the bases of the tentacle. Both lateral margins of the peronium touch the adjacent peronial canals (*ck*).

The four collar lobes ("lobi collares," fig. 4), which are separated by the four peronia, are of a broad uniform shape; their broad proximal basis falls in the coronal furrow of the exumbrella, whilst their distal point forms the usually projecting part of the umbrella margin (figs. 2, 3). Its distal external margin, which bears three auditory clubs on each lobe, is joined to the velum; the lateral margins are limited by the peronia. The lobe pouches (with the sexual products) lie in the concave internal or axial surface of the collar lobes, whilst the external or abaxial half is vaulted convexly. The thin gelatinous plate of the lobes is considerably thickened in the middle, and a sharp edge of the exumbrella projects like a rib in the interradial middle line (figs. 1, 4, *er*).

As in all Narcomedusæ, the peculiar umbrella margin in *Cunarcha æginoides* is strongly indented in consequence of the dorsal change of position of the tentacles, and supported by a strong urticating ring (fig. 4, *nc*; fig. 7, *nc*). This consists, like the peronia, of thickly accumulated nematocysts, and is covered with a ciliated sensitive epithelium. The proximal margin of the urticating ring touches the annular canal (*cc*), its distal margin rarely touches the velum (*v*). The two thin nerve rings (fig. 7, *rc′* dorsal or exumbral, *rc″* ventral or subumbral nerve ring) which are separated from one another by the supporting lamellæ of the velum, lie on the two edges of the urticating ring. The radial section (fig. 7) shows the more special anatomical and histological conditions of the umbrella margin. (Comp. the explanation.) The umbrella margin of *Cunarcha æginoides* has sixteen tentacular organs, namely, four long strong perradial tentacles, four interradial large auditory clubs, and eight adradial smaller auditory clubs.

The four perradial tentacles, which are common to *Cunarcha* and the nearly related *Cunantha*, remain permanent only in these two genera, whilst in all remaining Cunanthidæ this original number either increases or only amounts to four in the first early stage. As in all other Narcomedusæ, the tentacles are solid and fastened in the gelatinous substance of the umbrella by a peculiar "tentacle root." At the point of insertion of the tentacle where the "root" runs into the gelatinous substance, both tentacle and root are in continuous connection with the proximal end of the peronium, whose distal end passes into the urticating ring of the umbrella margin. The muscle and the nerve of the clasp, which maintain direct communication between the nerve ring of the umbrella margin and the tentacles, run on the axial side of the peronium. We may therefore say that the solid dorsally inserted tentacles are composed of three essential parts, which join at the point of insertion, viz., (1) the tentacle filament or the free projecting part; (2) the tentacle root, which is enclosed as a support in the gelatinous substance; and (3) the peronium which maintains the connection with the umbrella margin. The tentacle filament, or the free projecting part of the tentacle (figs. 4, 6 *l*), shows precisely the same structure which we have already described in the solid tentacles of the Pectyllidæ. The endodermal axis, which originates from the endoderm of the circular canal, forms a cylindrical column and consists of a single row of large, clear, discoid chordal cells, lying one above the other like the coins in a rouleau of sovereigns. The conical or carrot-shaped tentacle root (figs. 4, 6, *lr*), a direct process of the endodermal axis, projecting more or less into the gelatinous substance of the umbrella, consists of similar cells. The point of it has a centripetal direction and lies with its lower (umbral) side on the upper (exumbral) side of the gastral pouch, which it likewise serves to support firmly. A structureless septum divides it from the gelatinous substance covering it, and from the adjacent endoderm of the vascular system. The exodermal epithelium of the free tentacle filament, which consists partly of thread cells, partly of sense cells, does not run from its insertion at the root, but passes continuously into the urticating epithelium of the peronium. The urticating cells, which contain nematocysts, are tolerably equally distributed; so are the sense cells, which partly bear cilia or feeling bristles. At the club-shaped swollen distal end of the tentacles, the spheroidal thread cells are more thickly accumulated, and the cilia of the sensitive epithelium considerably prolonged so as to form a thick bunch (fig. 3). The part of the insertion of the tentacle, where filament, root and peronium join, is surrounded as with a collar by a thick semi-circular urticating swelling (figs. 2, 4, 6, *n*).

The twelve auditory clubs of this species, as in all Narcomedusæ, must be regarded as "modified acoustic tentacles" (System der Medusen, p. 307). The four interradial (primary) auditory clubs which lie on the point of the four coronal lobes, are from two to three times as large as the eight adradial (secondary) (fig. 4, *ok*). The free projecting lithocyst is club-shaped, and sits with a thinner short stalk upon a flat roundish "auditory pad" (figs. 4, 6, 7, 8). The solid axis of each auditory club consists of three to four short, broad, discoid endodermal chordal cells, of which the proximal is the smallest, and continuously connected with the endodermal epithelium of the annular canal. The distal end cell of the axis, on the other hand, is very large, and encloses a prismatic crystalline otolite (fig. 8, *ol*). The sense-epithelium forming the exodermal covering of the auditory clubs is composed of very long, fine auditory cilia, which diverge radially and so form a bundle in whose axis the club is placed (figs. 7, 8, *oh*). An auditory clasp, also termed a "marginal mantel clasp" or "centripetal urticating streak" ("otoporpa," fig. 4, *oo*; fig. 8, *oo*), runs from the basis of each auditory club. It is a broad thickened streak of the exodermal epithelium, consisting of a thick accumulation of thread cells and covered with ciliated sense cells. The longitudinal axis of the auditory clasp is a centripetal prolongation (sometimes straight, sometimes broken) of the longitudinal axis of the auditory clubs; both lie in the same meridian plane. The auditory clasps of *Cunarcha æginoides* are of the same nature as those of *Cunoctantha polygonia* (System, p. 317, taf. xix. fig. 2). They are shorter and stumpier than in most other Cunathidæ, almost triangularly club-shaped, gradually broadened from the thin distal end (at the marginal urticating ring) towards the broad proximal end, and ending there in a thick crescent-shaped urticating swelling similar to that at the insertion of the tentacle (figs. 4, 8, *op*). Like the three auditory clubs of each collar lobe, the auditory clasps belonging to them are very unequal in size, the medial (interradial) two to three times as long and broad as the two lateral (adradial); whilst the latter only project slightly above the proximal margin of the annular canal, the former extends till between the two lobe pouches of each lobe (figs. 2, 3, 4, *op*).

In *Cunarcha æginoides*, as in all other Narcomedusæ, the peculiar "subumbrella" is limited to the concave ventral side of the peripheric umbrella collar, whilst the entire ventral surface of the central umbrella lens is occupied by the broad gastral disk. The circular coronal muscle of the subumbrella consequently forms a broad muscular ring, which only lines the concave surface of the four collar lobes; its upper or proximal line of limitation touches the coronal furrow and the periphery of the stomach, whilst its lower or distal margin is divided from the strong velum by the urticating ring and nerve ring of the actual umbrella margin.

The velum is of considerable breadth, thick and compact, considerably broader at the four perradial peronial indentations of the umbrella margin than at the four interradial points of the collar lobes (fig. 1, 3, *v*); it is sometimes extended tensely horizontally, and in that case it narrows the entrance to the umbrella cavity so much that only a narrow opening for the passage of the œsophagus remains; sometimes it projects downwards like a funnel (fig. 3, *v*), and sometimes it hangs loosely and vertically from the umbrella margin like a compact multifold curtain. Like the four-lobed umbrella collar, the broad velum as well as its distal process, present a very different appearance according as they are dilated or contracted, and this is also the same with the umbrella cavity, of which they form the wall (comp. figs. 1, 3, 6). The latter usually appears as a narrow annular hollow space, whose internal (axial) wall is formed by the conical basal half of the œsophagus, and its external (abaxial) wall formed above by the umbrella collar, below by the velum. The upper (proximal) margin touches the peripheric margin of the gastral cavity, and corresponds to the exumbral coronal furrow, whilst the lower (distal) margin forms the opening of the umbrella cavity.

The gastrovascular system (figs. 1, 4) is divided in *Cunantha æginoides*, as in all other Narcomedusæ, into two essential and very distinct principal parts—into the central stomach with œsophagus, and the peripheric corona of pouches with a circular canal; the former is fastened to the ventral side of the central umbrella lens, the latter to that of the peripheric umbrella collar. The central stomach (*gc*) is a flat circular pouch, whose horizontal covering or upper aboral wall is formed by the lower, slightly convex, depressed surface of the central gelatinous lens of the umbrella. The bottom or lower wall of the central stomach, on the contrary, is only a narrow ring, whose thick muscular wall extends downwards like a cone, and becomes a long strong œsophagus (fig. 3, *gt*). This œsophagus is very mobile and contractile, nearly as long as the horizontal diameter of the umbrella, the upper half conically funnel-shaped, the lower half nearly quadrangularly prismatic; it ends below in a narrow oral opening, which sometimes seems quadratic, sometimes circular (fig. 3, *na*). Like the whole lower wall of the stomach, the proboscis-like œsophagus is capable of great extension and contraction.

The peripheric corona of pouches which runs from the periphery of the basis of the stomach (towards the inside of the coronal furrow) begins with four broad perradial gastral pouches, lying crosswise (figs. 2, 4, *bg*), whose upper (adumbral) wall is supported in its perradial middle line by the stiff tentacle root lying on it (*tr*). The breadth of the four gastral radial pouches increases remarkably towards the outside, and surpasses the length considerably; after a short course they bifurcate into two semi-oval cæcal pointed lobe pouches (figs. 2, 4, *bl*). These fill the largest part of the subumbral wall of the collar lobes, and at the same time represent the genitalia, as the ova are developed from the exodermal epithelium of their subumbral wall (fig. 4, *so*). Only a few (two to four) large ripe ova lie in each lobe pouch, among numerous others very small and undeveloped. A double clasp canal or peronial canal (fig. 4, *ck*) runs out between the two lobe pouches of each perradial gastral pouch from the middle of the distal end of the latter. This double canal consists of two narrow parallel tubes, which are separated by the deep furrow of the peronium or umbrella clasp. The two parallel canals diverge on the umbrella margin, at the distal end of the peronium, turn almost rectangularly in contrary directions, and run along the distal margin of the umbrella lobe, in whose centre they unite with the half of the corresponding neighbouring canal running towards them. In this way there is formed a peculiar annular canal shaped like a garland or a festoon, whose arches border the periphery of the umbrella lobes, and whose inverted corner corresponds with the insertion of the tentacle. In proportion, as the arches of the lobe collar in the Cunanthidæ becomes rounded, the shorter is the double canal, which connects the free-arched margin of the annular canal with the radial gastral pouch, and the longer at the same time the festoon canal, as we may suitably term the annular canal, with its bow-shaped archings inwards. However isolated this formation of the vascular system in the Cunanthidæ may appear at first sight, it may easily be referred back to that of some of the closely allied Trachomedusæ (especially the Geryonidæ). In these Geryonidæ, in which the flat "genital layers," or pouch-like broadened radial canals only reach to the annular canal, we only require to insert the indentation of the umbrella margin deeper into the opening place of the annular canal, and to represent the umbrella clasps as running straight through to the basis of the tentacles, in order to have the formation of the Cunanthidæ. The annular canal of the Geryonidæ (and of the remaining Craspedotæ) consequently corresponds to the entire "festoon canal" of the Cunanthidæ, which is composed of the double peronial canals and the peripheric "marginal canal" (lying on the marginal urticating ring), which connects them. On the other hand, the four broad perradial "gastral pouches" of *Cunantha* and *Cunarcha* correspond to the four typical "radial canals" of the Craspedotæ, which are also sometimes extended like a ribbon (as, for example, *Liriope* and *Glossocodon*). The two lateral wings of the last, in which the sexual products develop, may also be compared to the two sexual "lobe pouches" of *Cunarcha* (comp. my System der Medusen, 1879, pp. 304, 306, taf. xix. fig. 2 ; taf. xx. figs. 1, 2). The paired lobe pouches of *Cunarcha* and *Cunoctantha* (*l.c.*, taf. xx. figs. 1, 2) are at the same time nothing else than the "internemal gastral pouches" of the Æginidæ (*l.c.*, taf. xx. fig. 11). *Cunarcha* therefore appears to be a very interesting phylogenetic intermediate form between *Cunantha* and *Ægina*, immediately connecting these two tetranemal parent genera of the Cunanthidæ and Æginidæ with each other. (Comp. the tabular "Uebersicht über die Homologien der Radial-Canäle einiger tetranemalen Trachomedusæ and Narcomedusæ" in my System der Medusen, 1879, p. 336.)

Family, PEGANTHIDÆ, Hæckel, 1877.

PEGANTHIDÆ, Hæckel, System der Medusen, 1879, p. 323; taf. xix. figs. 4–7; taf. xx. figs. 14, 15.

Narcomedusæ without radial canals and without gastral pouches in the subumbrella, but with a festoon canal (or a circular canal formed by a circle of separate lobe canals), with otoporpæ or auditory clasps at the basis of the auditory clubs.

Sub-family, POLYXENIDÆ, Hæckel, 1877.

Peganthidæ with a single circular genitalium, forming a simple or lobed girdle in the subumbral wall of the stomach.

Polycolpa,[1] Hæckel, 1879.

Peganthidæ with a simple reproductive girdle forming a broad ring in the lower wall of the stomach (with genital cæca in the lobe cavities). Numerous (10 to 30) collar lobes, and the same number of tentacles alternating with them.

Polycolpa is the simplest, and phylogenetically the oldest genus in the family Peganthidæ, that peculiar group of Narcomedusæ which are distinguished by the complete want of the radial canals, and by the formation of a bow-shaped festoon canal. Whilst the most closely related Cunanthidæ have still several true radial canals (in the form of broad pernemal "gastral pouches"), these disappear completely in the Peganthidæ, inasmuch as the strong tentacles by their dorsal change of position occupy the whole of the umbrella margin up to the periphery of the stomach, where they are inserted. The original radial canal (the "gastral pouch") as well as the peronial double canal, undergo retrograde formation; both become lost. The annular canal, however, is divided into the same number of isolated vessels as there are lobes of the umbrella collar. Each horseshoe-shaped lobe-canal or bow canal edges the margin of its lobe, and opens at base of the latter immediately into the gastral cavity (beside the insertion of the tentacles) by two separate mouths. The whole gastrovascular system in the Peganthidæ therefore consists only of the flat lens-shaped gastral sac and the circle of isolated lobe canals, each opening with two mouths into the periphery of the stomach. Of the four genera of the Peganthidæ, which are all closely related, *Polycolpa* appears to be the simplest and oldest form, as it has the primitive formation of the genitalia. The simple genital girdle forms a broad undivided ring in the lower or subumbral wall of the stomach. It does not send out cæcal or pouch-like processes into the separate lobe cavities as in the closely related genus *Polyxenia* and in the genera *Pegasia* and *Pegantha*, derived from the latter.

Polycolpa forskalii, Hæckel (Pl. X.).

Polycolpa forskalii, Hæckel, 1879, System der Medusen, p. 328, No. 350.

Umbrella flat and discoid; two to three times as broad as high. Twenty-five lobes, nearly pentagonal; none as long as broad. Genital girdle very broad, occupying nearly the whole lower wall of the stomach. Twenty-five tentacles, three times as long as the radius of the umbrella; 130 to 170 auditory clubs (5 to 7 on each lobe). Horizontal diameter, 20 to 30 mm.; vertical diameter, 8 to 10 mm.

Habitat.—The Indian and Pacific Oceans. I myself observed a living (female) specimen of this species in the Red Sea. It was taken in the tow-net at a depth of above 60 fathoms, and the figures in Plate X. are drawn from it. I recognised, as I believe, the same species in an incomplete fragment found by the Challenger expedition near Mindanao, one of the Philippine Islands, at a depth of 82 fathoms. Station 201. Lat. 7° 3′, long. 121° 48′ E. 26th October 1874.

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[1] Πολύκολπα, with many curves (at the umbrella margin).

I name this species in honour of the meritorious Swedish naturalist, Peter Forskal, who not only gave the most trustworthy description of Medusæ in the last century, and was the first to describe the Medusæ of the Red Sea, but also (in 1775) made the first (and hitherto best!) description and drawing of a Peganthid (*Polyxenia mollicina*).

The umbrella (Pl. X. figs. 1-3) is depressed, discoid, nearly two to three times as broad as high, and divided, as in all Peganthidæ, by a deep horizontal coronal furrow (fig. 3, *ec*), into an upper half, the massive umbrella lens, and a lower half, the lobed umbrella collar. The thick umbrella lens ("umbrella disk" or "gelatinous mantel") consists of a planoconvex or biconvex gelatinous mass of a cartilaginous or even caoutchouc-like consistency. The solidity of the gelatinous disk, connected with a high amount of elasticity, attains its maximum among the Craspedotæ in this family. The cause of this extreme solidity are the innumerable branched, net-like, anastomosed, elastic fibres which run crosswise through the gelatinous substance from the external to the internal surface of the umbrella. The vertical thickness of the umbrella lens is one-third as great as its greatest horizontal diameter. The exumbrella is flat, without any special distinguishing character (fig. 2). The umbrella collar, which is sharply divided from the umbrella lens lying above it by the deep circular constriction, consists of a circle of twenty-five thick gelatinous lobes, and of the broad velum, which not only completely fills the interspaces between the lobes or the pernemal incurvatures of the subumbrella, and connects them like a swimming membrane, but also projects inwards a considerable way about the external margin of the lobes. The limits of the umbrella collar and the umbrella lens is marked by a circular line, in which the tentacles are inserted, and in which the openings of the festoon canal in the periphery of the stomach lie. (Comp. figs. 2, 3, 6.)

The umbrella lobes—or more accurately "the gelatinous lobes of the umbrella collar"—consist of a process of the gelatinous substance of the lens, which becomes thinner towards the exterior in the direction of the margin of the lobes. Although the thickness of the gelatinous substance in the lobes is not nearly so great as that of the central lens, it is still considerable, and the lobes have great solidity. It is therefore difficult to flatten out the marginal lobes, which are strongly rolled inwards both in the living and the dead animal. The circle of rolled-up lobes makes the umbrella here (and still more in other Peganthidæ) look like the flower of the turncap lily (*Lilium martagon*). The outline of the collar lobes is sometimes more rectangular, sometimes more pentagonal, according to the state of contraction (figs. 1, 2, 6). The lateral margins, as well as the point, is always strongly curved inwards; its exumbral external surface is, therefore, strongly curved both in a radial (longitudinal) and a tangential (transverse) direction.

The subumbral internal surface is strongly concave, corresponding to this external vaulting, and forms a protecting cavity, which is only open in a radial direction towards the umbrella cavity. We shall designate these cavities, which are essentially niches or secondary cavities of the umbrella cavity, and surround it like the altar niches of a circular temple (Pantheon), the lobe cavities; in most other Peganthidæ (as in the following species *Pegantha pantheon*) they serve for the reception and protection of the genital sacs, which branch out from the gastral genital ring. The central umbrella cavity itself (fig. 3, *h*), which is very flat and low as in all Peganthidæ, is limited above by the subumbral gastral wall and the genitalia lying in it, whilst it opens wide below (fig. 1).

The subumbrella is represented in the central part as far as the lower surface of the umbrella lens by the muscular subumbral gastral wall, as this extends to the borders of the lens and collar. In the peripheric part, on the other hand, at the lower surface of the umbrella collar, the subumbrella forms a circle of isolated muscular plates lining the inner concave surface of the lobes. The muscular ring of the subumbrella appears lobed in the lower part, from the proper margin of the umbrella (with the nerve ring and urticating ring), being deeply indented between every second lobe. The velum completely occupies the interspaces between the lobes to the umbrella margin like a swimming membrane, and moreover projects internally a little further than the connecting annular margin towards the axis of the umbrella cavity. The velum is very thick and compact, laid in many folds, and, like the lobes, almost always found more or less rolled up. Concentric annular folds predominate in the inner or axial part of the velum, whilst radial folds predominate in the outer or abaxial part, which runs in between the folds in the form of a triangular tip (figs. 6, 8, *v*). The subumbrella is so deeply indented between each two lobes that the triangular tips of the velum rise between them as far as their base and the insertion of the tentacles (figs. 2, 6). The structure of the subumbrella and of the velum is the same as in the next following species (comp. Pl. XII. fig. 12).

As the proper umbrella margin (in a morphological sense) is not determined by the free axial margin of the velum (the limit between exumbrella and subumbrella), but rather by the marginal urticating ring and the double nerve ring lying on it, the true umbrella margin appears deeply indented in *Polycolpa forskalii*, as in all Peganthidæ. It forms a continuous margin of the collar lobes and, at the same time, the frontier line between these and the velum (fig. 6, *nc*). The festoon canal lies on the inner margin of the urticating ring (fig. 6, *cf*) which accompanies it all along. The more minute structure of the umbrella margin is the same as in the following species (comp. Pl. XII. fig. 12). Of tentacular organs the umbrella margin bears twenty-five tentacles and a large number of auditory clubs (five to seven on each lobe).

The tentacles, whose number in all Peganthidæ equals that of the collar lobes, alternate regularly with the latter, and are inserted at the bases of every two lobes in the coronal furrow of the exumbrella (figs. 1-3, 6). The twenty-five tentacles of our *Polycolpa forskalii* are 1½ to 2 times as long as the diameter of the umbrella, and are sometimes curved upwards like a crown (as in *Pegantha pantheon*, Pl. XI. fig. 1), sometimes turned downwards under the umbrella (Pl. X. fig. 2); they are cylindrical, cartilage-like filaments, somewhat thickened at the bases, becoming gradually pointed finely towards the end, and combining a high amount of stiffness and firmness with considerable elasticity. The solid chordal axis resembles the chorda dorsalis of the vertebrata, and consists of large, clear, thick-walled endoderm cells, which have a firm elastic membrane, transparent contents, and a large nucleus. The chordal axis of each filament forms a single row or column of such coin-shaped chordal cells (comp. Pl. XII. figs. 10, 11). Its exodermal epithelium contains numerous spheroid nematocysts, especially in the abaxial side of the filament. The clear conical tentacle root is also composed of thicker chordal cells, it penetrates radially (centripetally) some wayfrom the insertion of the tentacles into the gelatinous substance of the disk, and often lies, bent like a hook, with its lower oral side on the periphery of the stomach (Pl. X. fig. 3, *tr*; fig. 7). A net of branched protoplasmic filaments radiating from the layer surrounding the nucleus is visible in each chordal cell of the root (fig. 7). The endodermal supporting plate, which encloses the chordal axis of the tentacles like a tube, also surrounds the root up to the point, which, on the other hand, the layer of longitudinal muscular filaments (lying outside the endodermal supporting plate) does not. "Umbrella clasps" or peronia, which appear so strongly developed in *Cunarcha* and *Æginura*, are only rudimentary in *Polycolpa* and *Pegantha* as in most Peganthidæ. As the deep indentations of the umbrella margin extend between each two lobes almost to the base of the tentacle, the peronia are naturally so much shortened that they almost disappear. By their retrograde formation the insertion of the tentacle remains in continuous direct connection with the urticating ring as it passes immediately into the former at the base of the lobes. The interlobar points of the velum, therefore, also extend to the tentacle root between each two lobes (fig. 6).

Polycolpa forskalii has 130 to 170 auditory clubs, 5 to 7 on each of the twenty-five lobes (fig. 6). One of them is placed on the point of the lobe, the others (in pairs opposite each other) on its lower lateral margin. Their structure is the same as those previously described in *Cunarcha*. Here, however, each of the 3 to 4 endodermal axial cells usually contains an otolite (fig. 8, *ol*). The otoporpæ or "auditory clasps" at their bases (fig. 8, *oo*) are club-shaped urticating streaks of the exumbrella covered with ciliated sense-epithelium with larger and smaller nematocysts (fig. 8, *n*). Their other functions are the same as in *Pegantha pantheon* (comp. Pl. XI. fig. 4).

The gastrovascular system (figs. 1, 3, 6, 8) has the special formation, peculiar to all Peganthidæ, which distinguishes this family of the Medusæ from all the rest. It consists of two principal sections, the central stomach and the peripheric festoon canal (fig.

6, *cf;* fig. 8, *cf*). The latter runs like a garland along the margin of the lobes and opens throughout between every two tentacles with a double mouth in the periphery of the stomach. The stomach is a completely flat, circular, or polygonal pouch, occupying the entire lower surface of the umbrella lens (fig. 3, *gc*). Corresponding to the latter, the upper wall or cover of the stomach forms a flat or only slightly convex, rarely concave, circular surface, whose periphery presents in certain conditions of contraction a regular polygon; each of its projecting corners corresponds to a tentacle insertion, each side of the base to the base of a collar lobe. The projecting corners sometimes form triangular pouches with the ends directed towards the insertion of the tentacle (last rudiments of radial pouches). The lower wall or bottom of the gastral pouch is a circular or regularly polygonal thick, muscular plate, covered with endoderm above and exoderm below. The oral opening, which is extended into a short cylindrical œsophagus hanging freely down, is in the centre (fig. 3, *at*). The thickened oral margin is simple, not split up into oral lobes. The muscular plate appear considerably swollen at the oral margin (longitudinal section, fig. 5, *m*). Numerous gland cells (*gd*) are scattered between the high cylinder cells of the gastral endoderm (*dg*), they are 2 to 3 times as broad as the latter, have twice as large a nucleus, and are distinguished by the turbid, granular nature of the protoplasm. As in all Narcomedusæ, the muscular wall of the stomach is capable of considerable contraction and dilatation.

The peculiar festoon canal ("canalis festivus," fig. 6, *cf;* fig. 8, *cf*) which attains its highest development in the Peganthidæ and the complete want of radial canals connected with it, suffices alone to characterise this family and to distinguish it from all other Medusæ. Phylogenetically this peculiar condition is simply derived from that of the Cunanthidæ, and from the fact that the stomach stretches by peripheric growth as far as the insertion of the tentacles (or to the limit of the umbrella lens and the umbrella collar), and so includes the broad pouch-shaped radial canals. The deep sinuses which are found in the Cunanthidæ between each two radial pouches are in some measure obliterated in the Peganthidæ. Hence the "triangular points" of the periphery of the stomach, which in some Peganthidæ run out to the insertion of the tentacles (already described by Eschscholtz in *Polyxenia* as "long three-sided processes of the stomach"), must, in fact, be considered the last rudimentary remains of radial canals. While in the Cunanthidæ the latter still serve to connect the stomach with the radial canal, in Peganthidæ the triangular points open into the periphery of the stomach in as many places as there are insertions of the tentacles between each two collar lobes. The circular canal has, therefore, the same disposition as in the nearly related Cunanthidæ; it runs along the velar margin of the collar lobes immediately under the urticating ring of the true umbrella margin; it is, however, interrupted at the basis of each two adjacent lobes by the insertion of the tentacle, and opens into the stomach beside the latter. The state of the case may be expressed thus: the annular canal of the Peganthidæ is divided into many (10 to 20) bow-like or semicircular lobe canals, running on the margin of the gelatinous lobes inside from the insertion of the velum, and opening at the bases of the lobes into the periphery of the stomach. The circular canal is, however, in no way reduced but forms a spacious tube, whose lumen in the larger species is often a millimeter in diameter and allows the introduction of a probe. Its endoderm is usually thickened and laid in folds, in some species even rising into numerous tufts or papillæ (like intestinal tufts). No such folds are recognisable in the transverse section of the festoon canal in our *Polycolpa forskalii*, whilst in the species immediately following a low annular fold is clearly present at the distal margin of the canal as in *Pectis* (comp. Pl. VI. fig. 12, *yc*, and Pl. XI. fig. 12, *yc*).

The reproductive glands in *Polycolpa forskalii* appear in their simplest form as a broad circular girdle, occupying the largest part of the lower subumbral gastral wall (fig. 1, *sf*; fig. 3, *sf*). In the living female specimen observed by me in the Red Sea, this girdle was of a beautiful sky-blue colour, so were the tentacles and the urticating ring of the umbrella margin; the points of the tentacles were dark-blue. The subumbral convex external surface of the reproductive girdle is tolerably smooth, and only traversed by insignificant and incomplete radial folds (fig. 1, *sf*). A thick compressed mass of small egg-cells, between which isolated large ova are scattered, appears in the radial transverse section (fig. 3, *sf*; fig. 4), between the high gastral endodermal epithelium of the ova (fig. 4, *dg*) and the flat subumbral exodermal epithelium (fig. 4, *qg*).

Sub-family, PEGASIDÆ, Hæckel.

Peganthidæ, with a circle of several separate genitalia, forming dilatations of the subumbral gastral wall and lying apart in the lobe cavities of the umbrella collar.

Pegantha,[1] Hæckel, 1879.

Peganthidæ, whose gastral reproductive girdle is divided into a circle of separate vesicle-shaped genital sacs, equal in number to the tentacles and alternating with them (a simple or multi-lobed cæcum in each lobe cavity). Numerous (10 to 30) collar lobes, and the same number of alternating tentacles.

The genus *Pegantha* represents the most complete and phylogenetically the youngest genus of the remarkable family of the Peganthidæ, in which the family type reaches its highest development. Whilst in the preceding genus *Polycolpa*, the ancestral genus of the family, the genitalium appears as a simple girdle in the lower wall of the stomach, which, in *Polycenia* and *Pegasia* develops into a peripheric circle of lobes, in

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[1] Πηγή, a spring; ἄνθη, a flower.

Pegantha the girdle is divided into a circle of completely separate perigastral genital sacs, one of each hanging freely in every lobe cavity of the umbrella collar (comp. System der Medusen, 1879, p. 327, pl. xix. figs. 4–7).

Pegantha pantheon, Hæckel (Pls. XI., XII.).

Pegantha pantheon, Hæckel, 1879, System der Medusen, p. 332, No. 359.

Umbrella crown-shaped, twice as broad as high, eighteen egg-shaped lobes, one-half as long as broad. In each lobe cavity a simple genitalium in the form of a broad roundish delicately-twisted leaf, eighteen tentacles twice as long as the radius of the umbrella, 400 to 450 auditory clubs (23 to 25 at each lobe). Horizontal diameter, 20 mm.; vertical diameter, 10 mm.

Habitat.—The South Pacific Ocean, near Mindanao, Philippine Islands. I found the extremely well preserved (male) specimen of this species, from which the figures in Plates XI. and XII. are taken, in the same bottle of the Challenger collection which contained the fragment of the preceding species. Station 201. Lat. 7° 3′ N., long. 121° 48′ E. 26th October 1874. Depth, 82 fathoms.

The umbrella (Pl. XI. fig. 1; Pl. XII. figs. 7–9) is shaped like a diadem or crown; is nearly twice as broad (20 mm.) as high (10 mm.), and divided by a deep horizontal coronal furrow into a massive upper half, the umbrella lens, and a lobed lower half, the umbrella collar. The massive upper part or umbrella lens consists, as in the previous species, of a tolerably firm biconvex gelatinous lens, of which the horizontal diameter is twice as great as the thickness (fig. 7, *ug*).

The exumbrella is distinguished by branched strongly-projecting ribs, between which deep radial furrows traverse the external upper surface (figs. 1–8). The ribs of the umbrella lens, which increase in thickness from the centre towards the periphery, are distributed so that a thicker principal rib runs in the middle of each collar lobe from which several thinner secondary ribs branch out laterally.

The umbrella collar consists of a circle of eighteen oval umbrella lobes (figs. 7, 8). These "gelatinous lobes of the umbrella collar" were closely pressed together in the specimen examined, and were so strongly rolled inwards, and of such a cartilaginous consistency that they could only be opened out flat under strong pressure (fig. 8, right half). They then appear of a broad oval, once and a half as long as broad. The convex external surface of each lobe (fig. 2) is strongly vaulted and traversed by five projecting longitudinal ribs of which the centre rib is considerably thicker than the lateral. The concave inner surface of each lobe (fig. 3) encloses a roomy lobe cavity, in which hangs a genital sac with folds. These eighteen lobe cavities (fig. 3, *hl*) form a circle of niches or secondary cavities round the central umbrella cavity, and surround it like the altar-niches of a circular temple (Pantheon). The central umbrella cavity itself is flat and low, opening wide below, whilst it is limited above by the subumbral gastral wall (comp. figs. 1, 7, 9).

The subumbrella, with its annular muscular layer is divided, as in the previous species, into two very different parts, limited by the circle of genitalia (fig. 9). The central part of the subumbrella, which corresponds in extent to the lower surface of the umbrella lens, is formed by the lower, folded, very muscular gastral wall, and appears pierced in the middle by the œsophagus (fig. 7). The peripheric part, on the other hand, is composed of the circle of isolated muscular plates which line the inner concave surface of the eighteen collar lobes. The velum completely fills the narrow interspaces of these lobes, and, moreover, projects freely a little way further over the points of the lobes like a connected circular edge (fig. 1, *ve*, right half *v*). Vertical sections of the firm velum (fig. 12, left) show that the upper (subumbral or ventral) epithelium of the velum (*vw*) is three times as high and as thick as the lower (exumbral or dorsal) epithelium (*vw*). A strong circular muscular layer lies on the former (*mv*), and a thick elastic supporting plate on the latter (*zv*).

As in the other Peganthidæ, the peculiar umbrella margin (characterised by the urticating ring and nerve ring) is deeply indented, and covers the selvage of the collar lobes like a connected edge. In *Pegantha pantheon* it forms eighteen deep curves reaching as far as the insertion of the tentacles (figs. 2, 3, 8, 12). In the radial transverse section of the umbrella margin (Pl. XII. fig. 12) the urticating ring (*na*) appears covered by dense epithelium with long cilia. The dorsal nerve ring (*rc′*) is divided from the ventral nerve ring (*rc″*) by the supporting lamella of the velum (*zv*); both lie immediately outside (abaxially) the insertion of the velum (comp. the explanation of fig. 12). The distal margin of the broad festoon canal (*cf*) touches the velum immediately. Of tentacular organs, the umbrella margin bears eighteen tentacles and numerous (over 400) free auditory clubs.

The eighteen strong tentacles, which alternate with the eighteen collar lobes and are inserted at their basis in the coronal furrow, were generally curved upwards in the specimen examined, as often happens in the Narcomedusæ (fig. 1). They are cylindrical, somewhat thicker towards the base, thinner towards the point, and nearly as long as the diameter of the umbrella. The endodermal axis is composed of a single row of coin-shaped chordal cells (a millimeter broad), in which the nuclei form a central chain (fig. 11). A visible layer of longitudinal muscular fibres (*m*) lies outside the strong supporting plate (fig. 10, *z*). The spheroidal nematocysts (*n*) in the exodermal epithelium are chiefly accumulated in the abaxial side of the tentacles, most thickly at the point. A thick, almost closed, urticating ring, which has only a break internally on the axial side (figs. 2, 3, *nb*) is placed at the insertion of the tentacles. Inside this the tentacles run into the pointed conical roots (*tr*) which pass centripetally into the gelatinous substance of the umbrella.

The auditory clubs in *Pegantha pantheon* are very numerous, 400 to 450, 20 to 25 upon each of the collar lobes (figs. 1, 2). They are regularly distributed along the bow-shaped umbrella margin, and run inwards immediately into the auditory clasps. The otoporpæ or auditory clasps (figs. 2, 4, *oo*) are all equal in length, nearly three times as long as the auditory clubs; their axis converges more or less towards the middle point of the lobe base (fig. 2). Their inner end is thickened and rounded like a club; their exodermal epithelium contains many larger and smaller thread-cells. The auditory clubs themselves are larger than in most other Narcomedusæ, and contain an axis of three to five, usually four, large endodermal cells, each enclosing a crystal. The proximal otolite (at the thin end of the auditory club) is the smallest, the distal otolite (in the club-shaped rounded end) the largest, and between these one or two medium-sized crystals (in the middle endodermal cells). The auditory club is surrounded by a stiff bunch of auditory hairs (*oh*), which run out from the auditory pad (*op*). After treatment with acetic acid and carmine, a nucleus coloured red (perhaps the original cell nucleus enclosed by the formation of the otolite) was visible in the centre of the otolite (fig. 12, *ol*). The manner in which the auditory clubs and their auditory clasps are disposed upon the umbrella margin, and their relations to the adjacent organs will be best understood by a comparative study of figs. 2 and 4 in Plate XI. and figs. 7 and 12 in Plate XII. In fig. 12 especially it is clear how the auditory club rises on a thin stalk from the conical auditory pad (*op*) of the urticating ring (*nc*), and how the fulcral lamella (*z*) between the two nerve rings (*nc*) passes through to the base of the auditory club, and thence into its supporting plate.

The gastrovascular system (Pl. XI. figs. 1, 3; Pl. XII. figs. 7, 9, 12) is, on the whole, the same as that already described in *Polycolpa forskalii* (comp. above, p. 34, and Pl. XI. figs. 1, 3, 6, 8). The stomach also forms a wide, flat, circular pouch, occupying the whole lower side of the umbrella lens (fig. 7, *gc*). Whilst the slightly convex lower surface of the latter forms the cover of the gastral cavity, its bottom is formed by the very muscular and extensible central part of the subumbrella, which is laid in a large number of radial folds (fig. 9). A short, wide œsophagus hangs down in the middle of the folds, its ample oral opening showing a swollen, thickened oral margin (fig. 7, *qg*). The peripheric part of the gastrovascular system is formed by the festoon canal, which is composed, in this species, of eighteen separate lobe canals (comp. above, p. 35). The latter run on the inner side of the urticating ring along the margin of the oval collar lobes, and open at their bases immediately into the periphery of the gastral cavity (fig. 3, *go*). The two openings take in between them the stalk of the genital sacs, which hangs in the relative lobe cavity (fig. 3, *oc*). The ribbon-shaped flattened canals are nearly one-eighth as broad as the greatest breadth of the lobes. Their subumbral endodermal epithelium (fig. 12, *dw*) is composed, as usual, of very high narrow cylindrical cells, whilst that of their umbral wall (*dw*) consists of many flat, flagellate cells. A low endodermal fold, like that in *Pectis* (Pl. VI. fig. 12, *yc*), but less strongly developed, rises at the distal margin of the festoon canal, projecting freely into its lumen (Pl. XII. fig. 12, *yc*).

In contrast to the preceding *Polycolpa*, in which the reproductive glands appear in their simplest form as a circular closed girdle in the lower wall of the stomach, *Pegantha* shows us the most widely differentiated and highly developed form of the genitalia. Here the originally simple and connected genital girdle is divided into a circle of separate reproductive sacs, hanging freely in the periphery of the gastral cavity. Each lobe cavity of the umbrella collar receives one genital pouch, which is surrounded and protected by the concave subumbral surface of the collar lobes (Pl. XI. fig. 3; Pl. XII. figs. 7, 9). The genera of the Peganthidæ, *Polyxenia* and *Pegasia* represent connective intermediate forms between the two extremes *Polycolpa* and *Pegantha*, so that we have here the division of the simple subgastral reproductive girdle into a circle of separate pouches, shown in four different phylogenetic stages (comp. my System der Medusen, 1879, pp. 327–332). The cavities of the isolated reproductive sacs of *Pegantha pantheon* (fig. 5, *sc*) communicate with the periphery of the gastral cavity (figs. 7, 9, *sc*). Each of the eighteen genitalia has the shape of a thick roundish leaf, with the two edges turned towards the edges of the collar lobes, whilst the upper surface is delicately twisted or folded (fig. 3, *s*). The transverse section (figs. 5, 6) shows that the gastral endodermal epithelium of the sac cavity (*sd*) is composed of high cylindrical cells, and divided by a strong supporting plate from the mass of the spermatozoa (*sm*). On the other hand, the latter is in continuous connection with the gastral ectodermal epithelium of the subumbrella, from which it originates. Under stronger magnifying power, we find the same condition here which Hertwig described (1878) in *Cunina lativentris*. The superficial ectodermal layer of cells (figs. 5, 6, *sw*), which forms the subumbral cover of the testes, sends out supporting fibres containing nuclei (*zs*) into the subepithelial layer of cells lying beneath it. The larger cells of this layer (*sm*) usually lie inwards, touch the endodermal fulcral plate (*z*), and must be regarded as "mother cells of the spermatozoa," whilst the smaller cells, which usually lie outwards, form spermatozoa already ripe (fig. 6, *sz*).

Family, ÆGINIDÆ, Gegenbaur, 1856.

ÆGINIDÆ, Hæckel, System der Medusen, 1879, p. 334, taf. xix. fig. 8, 9; taf. xx. fig. 11–16.

Narcomedusæ with a marginal canal communicating immediately with the stomach by double peronial canals, with internemal gastral pouches (which have arisen from the distal lobe pouches of radial canals through retrograde formation), without otoporpæ or auditory clasps at the basis of the auditory clubs.

Sub-family, ÆGINURIDÆ, Hæckel, 1879.

Æginidæ with eight peronial double canals (four perradial and four interradial).

Æginura,[1] Hæckel, 1879.

Æginidæ having eight peronial double canals and eight tentacles (four perradial and four interradial), and also sixteen internemal reproductive pouches, alternating in pairs with the eight tentacles.

The genus *Æginura* shows twice as many tentacles and reproductive pouches as the well-known primitive genus of the Æginidæ, *Ægina*. The *Æginura myosura*, which I am about to describe, is the only species of this genus, and also the only species of Æginidæ of the Challenger collection, of which I can give a satisfactory account. A second species of this family, much larger, and of more complicated structure, which I placed in my System, 1879, as *Æginorhodus rosarius* (p. 345), proved on closer examination too much destroyed and badly preserved for any satisfactory description. I am even dubious if the diagnosis of the species taken from this fragment be correct.

Æginura myosura, Hæckel (Pls. XIII., XIV.).

Æginura myosura, Hæckel, System der Medusen, 1879, p. 343, taf. xix. figs. 8, 9.

Umbrella cap-shaped, twice as broad as high. Mouth quadrate or four-lobed, with cylindrical œsophagus half as long as the radius of the umbrella. Sixteen almost rectangular reproductive pouches, the two medial of each quadrant smaller than the two lateral. Eight tentacles alternately different; the four perradial larger, and inserted higher than the four interradial; the former nearly double the length of the radius of the umbrella, the latter the same length. Horizontal diameter, 30 mm.; vertical diameter, 15 mm.

Habitat.—Indian Ocean, south of Australia. I found a male specimen of this species somewhat damaged, but still pretty well preserved, in a bottle of the Challenger collection, containing numerous Phæodaria (*Aulosphera*, *Cœlodendrum*, &c.) from Station 159. Lat. 47° 25′ S., long. 130° 32′ E. 10th March 1874. Depth (apparently) 2150 fathoms. In the System der Medusen (p. 343), "Weber" was given by an oversight instead of "Challenger."

The umbrella (Pl. XIII. figs. 1, 2; Pl. XIV. fig. 11) has the shape of a flat cap or biretta; the upper surface flattened nearly horizontally (slightly depressed in the middle), whilst the side walls stand almost vertically (slightly widened below). The largest horizontal diameter near the umbrella margin amounted to 30 mm., double the vertical height of the umbrella (15 mm.). As the umbrella margin in the specimen examined was strongly contracted, the height in the living animal must be proportionately greater (20 mm. or more). The umbrella, seen from the upper or lower surface, appears distinctly octagonal, as the eight principal radia (with peronia and tentacles) project more strongly outwards than the eight interlying side walls (fig. 2), so that the umbrella of the dead Medusa has really the shape of a short, regularly octagonal prism. The gelatinous substance of the umbrella is tolerably soft (as in all true Æginidæ), not so firm as in the Cunanthidæ and Peganthidæ, though there, as here, it is traversed by numerous elastic fibres. The gelatinous umbrella is very thick throughout the flattened apical surface (equal to one-third of the height of the umbrella) but very thin (and decreasing proportionately below) on the thin lateral walls (fig. 11, *ug*).

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[1] *Æginura*, *nomen proprium*.

The exumbrella is flat, without any special characteristic, and only traversed by eight shallow peronial furrows (fig. 7, *es*); these run vertically from the insertion of the tentacles to the umbrella margin, and are connected by thin "peronial plates" with the peronia or "umbrella clasps" lying beneath them (*em*). The eight peronial plates ("laminæ peroniales," figs. 7, *em*; 12, *em*) consist of a double layer of the exodermal flat epithelium of the exumbrella, and originate from the two gelatinous walls of the umbrella, which limit the open peronial groove laterally in the Cunanthidæ (Pl. IX. fig. 5, *es*), but lie above the grooves with their edges fused together in the Æginidæ. The peronium in the Æginidæ is therefore completely enclosed by the gelatinous substance of the umbrella on the abaxial side, and by the subumbrella on the axial side, whilst in the Cunanthidæ the abaxial side of the peronium lies free at the bottom of the open peronial groove (Pl. IX. fig. 5, *en*). In *Æginura* the distal end of the peronium joins that of the peronial plate under the umbrella margin; both pass continuously into the marginal urticating ring (Pl. XIII. figs. 1, 2, 4, *nc*; Pl. XIV. fig. 11, *nc*).

The umbrella cavity and the subumbrella lining it do not present in *Æginura*, any more than in the other Æginidæ, any of the striking peculiarities which distinguish the two families of the Narcomedusæ, the Cunanthidæ, and Peganthidæ; the conditions do not differ essentially from those usual in the Craspedotæ. Hence it comes that the umbrella collar is not divided into separate lobes by deep peronial incisions, and the margin of the umbrella is therefore almost entire. The peculiar lobe cavities of the Cunanthidæ (Pl. IX. fig. 6, *nl*) and the Peganthidæ (Pl. XII. fig. 7, *nl*) are consequently wanting. In *Æginura* the umbrella cavity is more a simple cylindrical, or almost octagonal, hollow space, with the œsophagus hanging in its axis, whose horizontal roof is formed by the subumbral bottom of the stomach (Pl. XIV. fig. 11, *gw*), whilst it opens wide below, and is limited laterally by the vertical side walls of the subumbrella. The latter has an unbroken broad layer of circular muscular fibres, which is divided by the eight peronia into eight quadrangular plates, but not cut through by it (comp. figs. 7, 11, 12, *mw*).

The velum (*v*) in *Æginura*, as in the other Æginidæ, is tolerably broad and strong, though not so thick and muscular as in the Cunanthidæ and Peganthidæ. Nor does it form the peculiar lateral points which project vertically into the deep peronial incisions of the umbrella margin, between each two collar lobes, as in the last-named families. As the collar lobes in the Æginidæ are not divided, but united below as far as the umbrella margin by the peronial plates, the velum is nearly of equal thickness throughout, and only slightly broader at the eight principal points where the peronia rise out from the eight corners of the umbrella margin (Pl. XIII. figs. 2, *v*; 4, *v*).

The umbrella margin (fig. 2) appears regularly octagonal from the slight curvings above mentioned at the principal points where the distal ends of the peronia and peronial plates run out from the urticating ring of the umbrella margin. Its cylindrical urticating ring is limited inside by the velum, outside by the distal margin of the exumbrella, above by the annular canal, and below by the double nerve ring. The sixteen subradial auditory clubs are placed on the abaxial external surface of the urticating ring, between the lower margin of the gelatinous umbrella and the upper margin of the velum, whilst the eight tentacles are inserted much further up on the exumbrella, at the height of the covering of the stomach.

The sixteen auditory clubs ("cordyli," Pl. XIII. figs. 1-3, *ok*) are placed strictly subradially, *i.e.*, they lie in the sixteen radial meridian planes, exactly in the middle between the eight adradial planes of third order, and the eight principal planes, in which the four interradial tentacles (second order) and the four perradial tentacles (first order) are placed. The auditory clubs are placed upon a hemispherical auditory pad (fig. 3, *op*), a wart-like swelling of the urticating ring, which apparently conceals a "ganglion acusticum;" at least the ganglion cells of the dorsal nerve ring are much more thickly accumulated there (fig. 10), and are connected immediately by numerous fine nervous fibrillæ, with the high cylindrical sense cells covering the auditory pad. A thick bunch of very long, fine auditory hairs radiate from the pad (fig. 3, *oh*). The auditory club, which is very thin at the base and considerably enlarged at the distal end, is placed in the axis of the conical bunch. Its endodermal axis consists of 5–6 chordal cells, of which the 2-3 proximal are very small and without otolites, but the 3–4 distal very large, and enclose otolites. The largest otolite in the terminal endoderm cell is sometimes nearly half as long as the whole auditory club. The ectodermal covering of the latter is divided from the endodermal axis by a delicate fulcral lamella (*z*), and consists of flat sense cells (fig. 3, *q*).

The eight tentacles are inserted high up on the exumbral surface, far from the umbrella margin, and only connected immediately with it by the eight long, strong peronia. A conical tentacle root (fig. 11, *br*) runs inwards from the point of insertion (at the proximal end of the peronial furrow), horizontally and centripetally, into the gelatinous substance of the umbrella, whilst the peronium (*em*) goes downward almost at a right angle to the umbrella margin. All eight tentacles have the same form and structure; the four primary perradial tentacles are, however, twice as long as the four secondary interradial, the former are also inserted somewhat higher, and the clasps of the latter are consequently somewhat shorter. The four perradial tentacles are somewhat longer than the largest diameter of the umbrella, the four interradial only about half so long. The free cylindrical tentacle filament (fig. 5, longitudinal section; fig. 6, seen from the outside) is more than a millimeter thick at the base, decreases towards the point like an awl, and is shaped like a mouse's tail ("myosura"). The solid axis resembles a rouleau of coin, and consists of a single row of discoid chordal cells whose nuclei lie in the centre, one behind the other (fig. 5, *ym;* comp. also Pl. XII. figs. 10, 11). The elastic structureless supporting plate enclosing this column of chordal cells (*z*), is covered by a layer of longitudinal muscular fibres (fig. 6, *mt*), above and outside which lies the single layered epithelium of the ectoderm (*d*). The spheroidal nematocysts (*m*) in the exoderm lie thickly together on the dorsal (abaxial) side of the tentacles, and form a raised urticating band (fig. 6, *m*), whilst they are only scantily distributed and of smaller size on the other sides of the tentacles.

The peronia or "umbrella clasps," which serve to connect the base of the tentacle with the urticating ring of the umbrella margin, are eight thick urticating streaks, gradually increasing in breadth from the top to the bottom (figs. 1, 2, 4, *en*). They appear egg-shaped in transverse section (figs. 7, *en;* 12, *en*), and under higher magnifying power they prove to be composed of the peculiar "peronial tissue" or "urticating skeletal tissue," which is the most important element in the urticating ring, and in the peronia and otoporpæ of the Narcomedusæ. This tissue (fig. 12, *en*) consists of compacted exodermal thread cells, varying greatly in shape and size. The roundish thread cells containing nematocysts enclose a long urticating thread, wound thickly and spirally; they have very thick walls, and are partly much larger (three to four times as large) than the ordinary largest nematocysts of the tentacles. These nematocysts are plainly incapable of throwing out their threads, but only serve with their thickened wall as firm "supporting cells." The inner axial side of the peronia is then closed on the exodermal epithelium of the subumbrella (figs. 7, 12, *qw*); also on the peronial canals, touching them laterally (*cts*) by a thick supporting plate, whilst its outer abaxial side touches the gelatinous substance of the umbrella (*wg*).

The tentacle roots (fig. 11, *tr*) are, as usual, conical, being a centripetal prolongation of the tentacle axis, consisting of a few large chordal cells of the endoderm, and having their points directed centripetally. They are covered by a structureless supporting plate, but have no exodermal epithelium. Their dorsal and their lateral surfaces are enclosed in the gelatinous substance of the umbrella, whilst their ventral surface lies immediately on the cover of the stomach (or the dorsal gastral wall), which it serves at the same time to support.

In *Æginura*, as in the other true Æginidæ, the gastrovascular system (Pl. XIII. figs. 1, 2, 4, 7; Pl. XIV. figs. 8, 11, 12) consists of two different principal parts, corresponding to the two principal parts of the umbrella, and separated by its coronal furrow (*ec*). The central gastral cavity with the œsophagus and oral opening lies on the subumbral side of the central lens of the umbrella, whilst on the subumbral side of the peripheric corona of the umbrella there is a circle composed of sixteen internemal reproductive pouches and eight peronial double canals, connected with the umbrella margin by an octagonal marginal canal, along with which it forms the "festoon canal." The central gastral cavity is flat and wide and regularly octagonal in outline (corresponding to the eight tentacle roots and peronial furrows). The cover of the stomach or the upper umbral wall is formed by the flat or slightly convex gastral surface of the gelatinous umbrella lens, into which the adjacent tentacle roots (*tr*) project centripetally as eight supporting edges. The bottom of the stomach or the lower subumbral wall, consists of a thick layer of circular muscular fibres, immediately connected on their lower surface with the ectodermal epithelium of the subumbrella (*w*), but separated on their upper surface by a thick supporting plate (*z*) from the high endodermal epithelium of the stomach. A cylindrical œsophagus (*gt*) hangs from the middle; it is nearly half as long as the whole radius of the umbrella, probably considerably longer in the living animal. The œsophagus is nearly as broad as long, and quadrangularly prismatic towards the lower end, where the four interradial longitudinal furrows appear, which divide the four broad bordering oral lobes (fig. 8).

The coronal intestine, which projects from the periphery of the central principal intestine, is composed of a circle of sixteen reproductive pouches, alternating in pairs with eight peronial double canals, and arises from the octagonal marginal canal along with which it forms the festoon canal. This festoon canal ("canalis festivus") is homologous with the festoon canal already described in *Cunarcha*, *Polycolpa*, and *Pegantha*, and really consists of eight internemal "lobe canals," which edge the margin of the eight quadrangular collar lobes of the corona of the umbrella. In *Æginura*, however, the lateral margins of these "collar lobes" are fused into the eight peronial furrows (*es*), so that each lobe canal is divided into a horizontal middle part (an octant of the marginal canal) and two vertical side limbs (the two inverted halves of two peronial double canals). At first sight a simple "circular canal" appears to exist upon the umbrella margin (Pl. XIII. figs. 1, 2, 4), which is connected with the stomach by the eight simple broad "radial canals" (as in many Craspedotæ, such as the Pectyllidæ, Pls. III.–VIII.). In the transverse sections (figs. 7, 12), however, we see at once and indubitably that the eight broad, apparently simple "radial canals" consist of two isolated "peronial canals" (*ck*) fully separated by the peronium. Each of the two adjacent peronial canals or clasp-canals open independently above (beside the insertion of the tentacles) into the periphery of the stomach, whilst it turns almost at right angles into the corresponding pieces of the marginal canal. The marginal canal ("canalis marginalis," *cm*) which runs along the proximal side of the urticating ring, is not however the usual marginal "circular canal" of the Medusæ margin, but consists of eight completely distinct pieces, separated from each other by the distal ends of the peronia. Each of these independent "octants of the marginal canal" runs at the two ends into a peronial canal, the two branches thus forming a horseshoe-shaped "lobe canal." Each lobe canal opens with two separate mouths into the gastral cavity beside the base of insertion of each two tentacles. The two peronial canals of each double canal and their two gastral openings (at both sides of a tentacle) therefore belong to two different "lobe canals." The eight lobe canals form collectively the eight-lobed "festoon canal," and this is phylogentically only a peculiar modification of the primarily simple "circular" canal, caused by the dorsal change of position of the tentacles and the formation of peronia connected with it.

The sixteen subradial reproductive pouches of *Æginura* show essentially the same formation already described by Mertens in *Æginopsis laurentii* (1838, *loc. cit.* Pl. VI.). They are quadrangular, almost rectangular, and distributed in such a way that a large and a small pouch is placed on each of the eight collar lobes (Pl. XIII. fig. 1, 2). The pouches, consequently, lie in internemal pairs, a pair between each two tentacles and peronia. It appears, however, on closer inspection that, as in *Æginopsis laurentii*, all the sixteen pouches actually belong to four primary groups. Two smaller pouches are placed on both sides of the four larger perradial tentacles, and two larger pouches on both sides of the four smaller interradial tentacles. If the whole umbrella be divided into four quadrants, whose middle lines form the four perradial peronia and the border lines the four interradial peronia, a group of pouches consisting of two small medial pouches and two large lateral pouches falls in each of the quadrants. The same condition is shown, if we suppose each of the eight lobe pouches of *Cunarcha* already described (Pl. IX. figs. 2–4, *bl*) divided by a centripetal incision of their distal margin into two pouches of unequal size, and the four proximal (perradial gastral-pouches), formed by the bifurcation of the eight lobe pouches, to have undergone retrograde formation. It is then clear that each group of four associated reproductive pouches belonging together in *Æginura*, is simply the double bifurcated distal part of a perradial gastral pouch, whose undivided proximal part has undergone retrograde formation (or become part of the central stomach).

In fact, it is only by such morphological comparison that we can understand phylogenetically the remarkable and varied conditions of vascular formation in the Æginidæ. The peculiar, apparently isolated, gastrovascular system of the Æginidæ, is, therefore, naturally derived from that of the Cunoctonidæ, from those Cunanthidæ (*Cunarcha, Cunoctona, Cunissa*) in which each radial canal (or each "pernemal gastral pouch") is cleft at the distal margin into two cæcal lobe pouches. If these paired lobe pouches become larger, and the undivided proximal piece of the pernemal gastral pouch undergoes retrograde formation at the same time, the former originate the characteristic internemal gastral pouches of the Æginidæ, which were primarily placed in pairs between every two tentacles (as in the tetranemal *Ægina*, System, 1879, p. 337, taf. xx.). The two pouches which have a tentacle between them are therefore the distal halves belonging to a former pernemal gastral pouch, *i.e.*, of a radial canal at the end of which each tentacle was originally placed. But the two pouches lying between every two primary tentacles are opposite distal halves of two adjacent radial canals. This view is justified by the fact, that in all the older and simpler forms of the Æginidæ two gastral pouches are always placed between every two tentacles. In our *Æginura* (as in *Æginopsis*) each of the eight lobe pouches is divided a second time. The peculiar formation of the festoon canals of the Æginidæ can only be explained in this way. It shows essentially the same conditions as in the Cunanthidæ. Here as there, the originally simple circular canal is divided into the same number of separate arches or "lobe canals" as there are umbrella lobes, and each lobe canal opens with two mouths beside the base of two neighbouring canals. But whilst in the Cunanthidæ the opening of the lobe canal is found in the middle of the distal margin, in the Æginidæ it occurs immediately in the periphery of the stomach. In the former the undivided proximal part or principal part of the radial canals (or of the pernemal gastral pouches) has entirely disappeared, and the internemal lobe pouches only are left (as remains of the divided distal part). The inverted halves of every two adjacent lobe canals are also connected with a "double canal" or double "peronial canal." In the Æginidæ, as the proximal half of the umbrella margin has retrograded, and the distal half become proportionally more strongly developed, the double canal appears very much prolonged, and has the deceptive appearance of "a simple radial canal opening into the periphery of the stomach between every two internemal gastral pouches." Thus very simple and clear homologies exist between formations apparently very different, as I have already shown in my System der Medusen, 1879, pp. 305, 306, &c.

The specimen of *Æginura myosura* was a male, and its sixteen testes (the sixteen "internemal gastral pouches") contained masses of ripe spermatoza. They did not however, fill up the cavity of the pouches, but were placed on the outside of its subumbral wall. In transverse sections the internal side of the subumbral wall showed the same high cylindrical epithelium as that of the peronial canals (figs. 7, 12), whilst the endodermal epithelium of the opposite umbral wall consisted, in both cases, of a thin layer of flat plate cells covering the gelatinous substance of the umbrella. The spermarium, on the contrary, lies like a thick plate immediately under the exoderm epithelium of the subumbrella from which it originates, and is divided from the high cylindrical epithelium of the endoderm by a distinct supporting plate. In *Æginura* as in Pegantha (p. 34, Pl. XI. figs. 5, 6), the subumbral ectoderm sends out supporting fibres containing nuclei into the spermarium which lies under it, and is derived from it. Here, therefore, as in all Craspedotæ, the sexual products originate from the ectoderm, whilst the reverse is the case in the Acraspedotæ, where, in both sexes, they are formed by the endoderm. The ripe spermatozoa and the ripe ova are therefore thrown outside immediately in the Craspedotæ or "Cryptocarpæ," whilst in the Acraspedæ or "Phanerocarpæ" they first pass into the gastrovascular system, and are then ejected by the oral opening; the former are therefore properly "Ectocarpæ," the latter "Entocarpæ" (Hertwig, 1879). When Eschscholtz, the meritorious founder of the system of the Medusæ, 1829, distinguished the two principal divisions of this class as "Cryptocarpæ" and "Phanerocarpæ" according to the different formation of their reproductive organs, he expressed prophetically an important difference, whose peculiar character was first more accurately recognised fifty years later.

CLASS II. ACRASPEDÆ, Gegenbaur, 1856.

PHANEROCARPÆ, Eschscholtz, 1829. STEGANOPHTALMÆ, Forbes, 1848.
SCYPHOMEDUSÆ, Ray-Lankester, 1877. PHACELLOTÆ, Hæckel, 1878.

Medusæ with gastral filaments or phacellæ; with endodermal genitalia (or sexual products from the internal germinal layer); without true velum (often with velarium); with true marginal lobes of the umbrella; without double centralised nerve ring. Phylogenetic descent (probably universal) and ontogenetic descent (at present still in the majority) derived from scyphopolyps with gastral filaments or from scyphostoma. Ontogenesis usually alternation of generations (in the form of strobilogenesis) often connected with metamorphosis. The sexual acraspede generation is formed by terminal gemmation from the asexual scyphostoma generation.

Order V. STAUROMEDUSÆ, Hæckel, 1877.

Acraspedæ without sense clubs, with simple tentacles or marginal anchors (adhesive tentacle rudiments). Originally eight principal tentacles (sometimes rudimentary).

Besides these eight principal tentacles there are often small secondary tentacles (usually in bunches upon eight adradial marginal lobes). Stomach having four wide perradial gastral pouches, which are separated by four narrow interradial septa or fused selvages, and connected on the umbrella margin by a circular sinus. Genitalia, four interradial horseshoe-shaped swellings or four pair of adradial swellings, which are developed in the subumbral wall of the gastral pouches from their endoderm, and project wholly or partially into their cavity.

Family, TESSERIDÆ, Hæckel, 1877.

TESSERIDÆ, Hæckel, System der Medusen, 1879, p. 371, taf. xxi.

Stauromedusæ with simple, undivided umbrella margin, without hollow marginal lobes or "arms." Eight principal tentacles (four perradial and four interradial) always present, not transformed into marginal anchors or sense clubs; besides these, sometimes numerous secondary tentacles. Coronal muscle of the umbrella margin circular, not divided into eight isolated marginal muscles. Either an apical process or an umbrella peduncle on the apex of the umbrella.

Sub-family, TESSERANTHIDÆ, Hæckel, 1879.

Free-swimming Tesseridæ, without a stalk, but with an apical process on the cone of the umbrella; with simple solid tentacles without terminal urticating knob.

Tesserantha,[1] Hæckel, 1879.

Tesseridæ, without peduncle, with an apical process and with sixteen simple solid tentacles without terminal urticating knob (four perradial, four interradial and eight adradial). The genus *Tesserantha* is one of the simplest and oldest Medusæ forms of that important family the Tesseridæ, which are to be regarded as the general ancestral group of all Acraspedæ. This primitive Acraspeda form is essentially merely a Scyphostoma with sixteen tentacles which, in adapting itself to a free-swimming mode of life, changed its oral disc into a subumbrella, and its basal peduncle into an apical process, divided the peripheric gastral space into four radial pouches by four interradial fused knobs, and became sexually mature in this form. *Tesserantha* is distinguished from the octonemal closely related *Tessera* by the addition of eight new adradial tentacles (of the third order) to the eight principal tentacles (four perradial and four interradial). Moreover, whilst in *Tessera* only four simple gastral filaments run out from the four septal knobs, as terminal free processes of the four interradial tæniola, the septal knobs in *Tesserantha* are beset with a double row of filaments throughout the greater part of their length (the proximal basal part alone excepted). In this and other respects, namely in the formation of four perradial mesogonial folds and four interradial funnel cavities alternating with these, *Tesserantha* comes nearer *Depastrella*, and therefore forms an interesting transition gradation between *Tessera* and *Depastrella*. At present there is only one known species of this genus, the deep-sea Medusa described below.

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[1] *Tesserantha*, four-sided flower.

Tesserantha connectens, Hæckel (Pl. XV.).

Tesserantha connectens, Hæckel, 1879, System der Medusen, p. 375, No. 402.

Umbrella helmet-shaped, one and a half times as high as broad, with conical apical process and peduncle canal on the top. Exumbrella with eight longer and eight shorter exumbral urticating ribs. Four double rows of gastral filaments along the four interradial tæniola inside the central stomach. Œsophagus quadrangularly prismatic, half as long as the height of the umbrella. Oral opening with four short, frilled, oral lobes. Eight simple horse-shoe-shaped genitalia enclosing the small septal nodes in the concavity of the arch. The eight principal tentacles (four perradial, four interradial) of equal length, nearly as long as the height of the umbrella; the eight secondary (adradial) tentacles only half as long. Horizonal diameter of the umbrella, 6 mm.; vertical diameter, 9 mm.

Habitat.—South-east part of the Pacific Ocean, not far from the island of Juan Fernandez, lat. 33° 31′ S., long. 74° 43′ W.; Station 299. 14th December 1875. Depth, 2160 fathoms.

The umbrella (figs. 1–3) is highly vaulted, bell or helmet-shaped, rather constricted beneath at the opening, just above the umbrella margin, and furnished above with a pointed, conical, apical process which is nearly a third as long as the whole height of the umbrella. It is about half as large again as the greatest horizontal diameter of the umbrella above the umbrella margin. The exumbrella is distinguished by eight projecting, strong, urticating ribs, four perradial and four interradial (figs. 1, *er*; 6, *er*). These are sharp corners of the outer surface of the umbrella, almost triangular in transverse section, which are armed with a broad streak of pigment cells and thread cells, and stretch uninterruptedly from the point of the umbrella cone to the eight ocelli of the umbrella margin, from which they pass on to the dorsal surface of the eight principal tentacles. Eight secondary incomplete longitudinal ribs alternate with the eight principal complete longitudinal ribs of the exumbrella; these are much narrower and shorter and only run from the bases of insertion of the eight adradial tentacles to half the height of the umbrella (fig. 1, *er*).

The umbrella margin is somewhat contracted by a circular marginal stricture, and is beset with sixteen tentacles, between which the gelatinous substance of the umbrella projects a little in the form of short, roundish, solid, gelatinous lobes (figs. 1, 4, *l*). The eight principal tentacles (four perradial and four interradial) are nearly as long as the height of the umbrella, whilst the eight adradial or secondary tentacles alternating with them, are only half as long. These also want the black roundish eye-spot ("ocellus," fig. 1, *oc*) which is found at the base of the eight principal tentacles. These ocelli consist of accumulations of black grains of pigment in the ectoderm of the tentacle basis. All the sixteen tentacles are solid cylindrical filaments, gradually becoming thinner towards the pointed distal end. Their structure resembles that of the oral styles of the Margelidæ (p. 1, Pl. I. fig. 5) and of the solid tentacles of the Peganthidæ (p. 30, figs. 10, 11, &c.) already described. Each tentacle, therefore, consists of four different layers: (1) a solid cylindrical endodermal axis, formed of a single row of clear coin-shaped chordal cells; (2) a thin but firm and very elastic fulcral plate; (3) a thin muscular plate composed of parallel longitudinal fibres; (4) an exodermal epithelium, bearing partly thread cells, partly pigment cells. The latter contain grains of blackish pigment, and are chiefly found on the abaxial or dorsal side of the tentacle, where they form a black longitudinal streak which represents the direct process of the ocelli and the exumbral ribs of pigment. The tentacles, with their basal ocelli, are the only organs of sense found in the *Tesserantha*, as in all Stauromedusæ; special auditory clubs, like those of the other Acraspedæ, are not present.

The deep cavity of the umbrella (subumbrella) consists of a lower simple cavity of the corona of the umbrella, whose vertical axis is occupied by the œsophagus (fig. 2, *at*), and of an upper quadrilocular part divided by four mesenteries into four conical funnel cavities (fig. 6, *ii*). These mesenteries or mesogonia (fig. 2, *wr*) are four thin perradial membranes, which stretch vertically between the four perradial angles of the base of the stomach and the middle line of the four radial pouches. They serve principally to attach the œsophagus, are cut out like a crescent at the lower free edge, and pass immediately into the tissue of the subumbrella at the upper, rather thinned, basal margin. The mesenteries must be regarded essentially as folds of the subumbrella, whose structure they share. We find them again in a similar form in the Charybdeidæ, Tiaridæ, and Pectyllidæ (Pl. IV. fig. 3, *wr*; Pl. VIII. fig. 9, *wr*). The four interradial funnel cavities ("infundibula subumbralia," fig. 6, *ii*), which are divided by the four mesenteric folds, are conical sacs, opening below into the umbrella cavity, but projecting more or less with their cæcal point into the central gastral cavity; their aboral extension could not be exactly defined; they perhaps extend as far as the tæniola are set with filaments, to the beginning of the basal stomach.

The muscles of the subumbrella are formed by two different systems, which are found more or less modified in all Acraspedæ; a distal system of circular muscular fibres and a proximal system of radial muscular fibres. The first form the typical coronal muscle ("musculus coronarius," figs. 2–4, *mc*), a broad octagonal ring on the umbrella margin, whose eight angles are defined by the bases of the eight adradial tentacles. The system of radial or longitudinal muscles is composed of eight triangular deltoid muscles, whose broad base rests on the proximal margin of the coronal muscle. The four perradial deltoid muscles (figs. 3, 4, *md′*) are narrower and longer, and pass above into the mesenteric folds. The four interradial deltoid muscles (figs. 3, 4, *md″*) are broader and shorter, and their truncated point is inserted at the four septal nodes (*kn*).

In *Tesserantha*, as in all Acraspedæ, the "gastrovascular" system consists of two principal parts, the central principal intestine and the peripheric coronal intestine. The central part or the axial principal intestine ("gaster principalis") communicates with the peripheric coronal intestine by the four perradial openings ("ostia gastralia"), and is divided into three different sections, the basal, the central, and the oral stomach. The aboral basal stomach or peduncle canal ("gaster basalis," *gb*), which may also be called the "apical canal," is a narrow, almost cylindrical, hollow space occupying the entire cone of the umbrella, in whose point it ends cæcally above, whilst below it opens by the pylorus (*gy*) into the central stomach. Four longitudinal gelatinous selvages, the important interradial tæniola, project from the inner surface into its hollow space, and, as in the closely-allied Lucernaridæ, traverse the entire length of the hollow basal umbrella peduncle (figs. 2, 3, 8, *ft*). The peripheric part of the basal stomach is thus divided into four perradial grooves (figs. 3, 8, *gb*).

The central stomach ("gaster centralis," *gc*) has, on the whole, a spheroidal or almost quadrangularly pyramidal form, which, however, is complicated by the four interradial exodermal funnel cavities (*ii*) sinking down into it from above. The distal processes of the four tæniola, each of which bears two rows of gastral filaments (*ft*) inside in the central stomach, run as projecting selvages on the endodermal gastral surface of the funnel cavities. The central stomach opens above by the "porta pylorica" (*gy*) into the basal stomach, below in the centre by the "porta palatina" (*gp*) into the oral stomach, and round by the four cleft-shaped gastral openings into the coronal intestine. The gastral openings (fig. 6, *go*) are narrow, almost horizontal clefts, divided from one another by the four interradial septal nodes ("nodi cathammales," *kn*), these important points of fusion at which the umbral and the subumbral wall of the gastral space have grown together. That this is really a fused plate is plain from the fact that an endodermal layer of epithelium—"endodermal lamella" or cathammal plate—runs in the middle through the cartilaginous-like gelatinous mass of the septal node.

The oral stomach or œsophagus ("proboscis," *ga*) is formed of a quadrangularly prismatic tube, nearly equal in length to the breadth of the umbrella (figs. 1, 2, *at*). It is four times as long as broad, and has four projecting perradial angles which run into the four mesenteries above, whilst the external surface is depressed like a groove between them (fig. 6, *a*). The oral opening is surrounded by an undulating oral margin crowded with thread cells, and runs out into four short perradial lobes (fig. 4 in the middle).

The peripheric coronal intestine ("gaster coronaris"), which in most Acraspedæ is divided into from four to sixteen radial pouches or canals, forms a simple wide coronal sinus ("sinus coronaris," *cs*) in *Tesserantha* as in *Periphylla*. It occupies the whole space between the septal nodes and the umbrella margin (figs. 2, 3, 5, *cs*). The broad gastral openings only may, therefore, be considered as homologous with the four radial pouches (*bp*); in fact, the four short septal nodes which divide the gastral openings correspond to the four longer septa or interradial selvages, which separate the four broad radial pouches in the Lucernaridæ (comp. Pls. XVI., XVII.).

The four reproductive glands (figs. 2, 3, 4, 6, *o*) in *Tesserantha*, as in *Tessera* and *Depastrum* (= *Carduella*) form four horseshoe-shaped swellings in the subumbral wall of the coronal sinus. Their central arch encloses the four septal nodes with its concave distal margin, whilst its concave proximal margin projects above into the central gastral cavity, and appears fimbriated with the lowest distal group of the gastral filaments. The two limbs of the U-shaped reproductive arches run upwards, diverging slightly into the subumbral wall of the coronal intestine, and their limbs, which are curved outwards, touch the proximal margin of the coronal muscle. In *Tesserantha*, as in *Tessera*, a thickened gelatinous selvage of the fulcral plate of the subumbrella appears to project into the hollow space of the coronal sinus, in the entire extent of the reproductive swelling, and the sexual cells appear to be developed from the endodermal epithelium of the sinus on the axial side of these genital selvages. The spirit specimen (a female) which I examined did not admit a closer investigation of its finer structure. Slight transverse folds are visible on the endodermal upper surface of the genitalia (figs. 3, 4, *s*).

Family, LUCERNARIDÆ, Johnston, 1847.

LUCERNARIDÆ, Hæckel, System der Medusen, 1879, p. 379, taf. xxii.

Stauromedusæ, with lobed or incised umbrella margin, divided by eight concave arches (four perradial and four interradial) into eight hollow adradial lobes or arms; a brush-shaped bunch of hollow knobed tentacles at the end of each arm; eight principal tentacles (four perradial and four interradial) either transformed into adhesive marginal anchors or wanting (having undergone retrograde metamorphosis, or lapsed). Coronal muscle of the umbrella margin divided into eight isolated marginal muscles. A peduncle for adhesion at the apex of the umbrella.

Sub-family, HALICLYSTIDÆ, Hæckel (ELEUTHEROCARPIDÆ, Clark).

Lucernaridæ without mesogonial pouches in the subumbral wall of the four radial pouches.

Lucernaria,[1] O. F. Müller, 1776.

Lucernaridæ without mesogonial pouches in the subumbral wall of the four radial pouches, and without marginal anchors or marginal papillæ (*Lucernaridæ eleutherocarpæ inauriculata*). Peduncle one chambered with four separate tæniola.

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[1] *Lucernaria*, like a candle; from *Lucerna*, a candle.

The genus *Lucernaria*, the oldest known form among the Stauromedusæ, was founded by O. F. Müller, more than a hundred years ago, for the large and widely distributed Acraspeda of the North Atlantic Ocean, which he named *Lucernaria quadricornis* (Prodom. Zool. Dan., 1776, p. 227). This notable and well-known form alone can therefore be taken as the typical species by which to define the character of the genus *Lucernaria*. Later authors, such as Keferstein, Leuckart, Taschenberg, and others, have, for the most part, placed all other later known Lucernaridæ in this genus. However, for reasons given in the System der Medusen (1879, pp. 380, 387), I considered the division of the true Lucernaridæ into four genera justified, and therefore limit the genus *Lucernaria* to the forms without mesogonial pouches and without marginal anchors (*Eleutherocarpidæ inauriculata*). The genus *Lucernaria* is distinguished from the closely allied genus *Haliclystus* (which is very minutely described by Clark in his monograph on *Haliclystus auricula*, 1878) by the absence of marginal anchors or marginal papillæ, and from the two other genera of the family (*Halicyathus* and *Craterolophus*) by the absence of the peculiar "mesogonial pouches or mesenteric pouches," which in the latter penetrate from the stomach into the subumbral wall of the four perradial gastral pouches. The species described below (from 3240 feet deep) is the first deep-sea Lucernarid, as all the other species of this family hitherto described, are littoral, or only found at moderate depths (from 20 to 50 feet at most). This species is, moreover, distinguished in several ways and by many peculiarities (especially by the slight development of the eight arms and the complicated structure of the genitalia) from the four other hitherto known species of this genus, so that it is perhaps better to constitute it the representative of a special genus, *Lucernosa*.

Lucernaria bathyphila, Hæckel (Pls. XVI., XVII.).

Lucernaria bathyphila, Hæckel, 1880, System der Medusen, p. 640, No. 597.
Lucernosa bathyphila, Hæckel, 1880 (*in litteris*).

Umbrella bell-shaped, when extended, nearly as broad as high. Peduncle almost rudimentary, conical, one-chambered, hardly one-sixth so long as the cavity of the umbrella, with four strong, linear, interradial, longitudinal muscles. Eight arms united in pairs. The four perradial arches of the umbrella margin three times as broad and deep as the four interradial arches; each arm with 80 to 120 tentacles; eight genitalia, very broad, separated by a broad interspace from the base of the peduncle as well as from the end of the arm, each genitalium composed of numerous (above 200) separate sacs, which again consist of a large number of isolated follicles. Horizontal diameter of the umbrella, 50–60 mm.; vertical diameter, 60–80 mm.

Habitat.—The North Atlantic Ocean, between the Faröe Islands and the Shetland Islands. Lat. 60° 3′ N., long. 5° 51′ W. Depth, 540 fathoms (John Murray). This species, the first Lucernarid from the deep-sea, was not taken during the Challenger expedition, but was part of the spoil of a subsidiary cruise in H.M.S. "Knight Errant," organised by Sir Wyville Thomson in the summer of 1880, with the view of verifying some of the Challenger results. I am obliged to him for giving me an opportunity of including this species in the list of Challenger Deep-sea Medusæ, as in many respects it has a peculiar interest as a link between the preceding *Tesserantha* and the following *Periphylla*.

The umbrella (Pl. XVI. figs. 1–8) is of a roundish bell shape, or almost pyriform, only a little longer than broad, and adhering by a very short peduncle at the aboral pole. The whole length (or height) (including the peduncle) of the spirit specimen examined came to 60 mm., the greatest breadth (in the middle of the height) to 50 mm. As, however, the specimen was strongly contracted, the height in the living animal would come to at least 70–80 mm., and the breadth to 55–60. This species, as well as the two closely allied species, *Lucernaria quadricornis*, and *L. pyramidalis* belong to the largest species of the family Lucernaridæ ; the latter has a much shorter stem but a smaller cup.

The peduncle ("pedunculus," *p*), by which the bell-shaped cup fixes itself to the bottom of the sea, is rudimentary and slightly developed in *Lucernaria bathyphila*, as in all other species of the family. It rather resembles the "apical process or conical process" of the Tesseridæ, from which it is probably derived (System der Medusen, 1879, p. 365, taf. xxi., xxii.). Its length amounts, at most, to one-sixth of the whole length of the body, but cannot be sharply defined, as the thicker oral end of the club-shaped peduncle passes gradually, without distinct boundary, into the cup. The thinner aboral end is truncated, and has a small roundish disc on the surface of the point of adhesion (fig. 8). This plate has numerous adhesive cells ("colletocystæ") in its thickened exoderm, it lies in irregular folds, and is divided by four deep interradial furrows into four perradial swollen lobes (fig. 8). Each furrow passes a little way into the exumbrella of the peduncle, so that it also appears four lobed in a transverse section above the disc (fig. 13). The four interradial, longitudinal furrows of the exumbrella of the peduncle have four corresponding gastral tæniola in its inner wall (figs. 1, 2, 21, *ft*) ; these are the important longitudinal, gelatinous selvages, already found in *Scyphostoma*, which traverse the entire length of the peduncle, and pass immediately below into the four interradial septa of the gastral pouches (fig. 12, *ks*). In the horizontal section these tæniola appear almost egg-shaped, compressed laterally, and only connected (as by a peduncle) by a very thin gelatinous plate (fig. 14, *ft*) with the wall of the umbrella peduncle, from which they project centripetally inwards. The gastral hollow-space of the peduncle is thus divided into four perradial peduncle grooves (fig. 13, *cp*) which communicate by narrower clefts with the central basal stomach (*gb*), and form a regular maltese cross seen in transverse section. The peduncle in our species is, however, one-chambered, as in all species of the genus *Lucernaria* (in the stricter sense). (System der

Medusen, 1879, p. 389). The four strong tæniola contain a well-developed, longitudinal muscle (figs. 13, *m*; 14, *m*); this is enclosed in a voluminous gelatinous sheath (*ft*), which is considerably thicker on the axial side than on the abaxial side, and which internally forms numerous dendritically branched folds. The muscular plate of the peduncle (*m*) is extended on these folds of the gelatinous supporting plate; it encloses a central axial cord of exoderm cells (*q*) lying in the axis of the tæniolum; there are the "epithelial muscular cells" of the exumbrella which have immigrated centripetally from its outer surface into the gelatinous selvage. The delicate figure shown by each tæniolum in its oval transverse section (fig. 14) consists, from its axis towards its periphery, of the following layers:—(1) The central cell-cord of the ectodermal epithelial muscular cells (*q*); (2) the folded muscular plate arising from it (*m*); (3) the fulcral lamella (*z*) with its dendritic supporting folds, and the thick gelatinous sheath surrounding it (*ft*); (4) the endodermal covering of the gastral epithelium (*d*).

The cup ("calyx"), or the peculiar "umbrella" of our *Lucernaria* (after removing the stalk) is almost oval, broadest in the middle, gradually passing into the conical peduncle above, and slightly contracted below towards the umbrella margin and the eight arms (figs. 1–3). As in all Stauromedusæ, the umbrella consists of two thin walls, an external convex umbrella and an inner concave subumbrella. The two walls enclose the hollow space of the gastrovascular system, pass into each other at the umbrella margin, and are otherwise only connected with each other by the four interradial septa ("lines of fusion, or cathammal selvages," *ks*). The two walls consist in section chiefly of a thin but firm gelatinous plate (fulcral lamella, *z*); its inner side is covered by gastral endoderm (*d*), its outer side by dermal exoderm (*q*). The external convex surface of the umbrella or the true exumbrella (*e*) is smooth, without special characteristics, and only traversed by four slight interradial longitudinal furrows (the distal processes of the peduncle furrow). The gelatinous substance under the exumbrella is not thick but very firm, and traversed by numerous elastic fibres which run from the outer to the inner surface of the gelatinous plate (fig. 13, *uf*); they are also equally numerous in the thin gelatinous plate of the subumbrella (fig. 18, *uf*). The ectodermal epithelium of both the exumbrella and the subumbrella is armed with scattered urticating organs (comp. my System der Medusen, 1879, p. 382).

The antrum or umbrella cavity ("necto-calyx") (*h*), which is lined by the ectoderm of the subumbrella (*qw*), is divided in our species, as in all Lucernaridæ, into two parts, the lower (distal), simple, coronal umbrella cavity, and the upper (proximal), quadrilocular, funnel umbrella cavity. The coronal umbrella cavity (fig. 5, *hc*, "antrum coronarium") is perfectly simple, cylindrical, or almost cubic, and occupies the entire lower half of the body; the eight deltoid muscles, and the distal halves of the genitalia lie in its subumbrellar wall. The funnel umbrella cavity ("antrum infundibulare," *i*) is divided from the coronal umbrella cavity by the oral boundary-line E F (figs. 2, 3), and is composed of four interradial pit-like depressions (figs. 6, 7, *ii*) separated from one another by four perradial vertical folds of the subumbrella (fig. 3, *wr*). These are Clark's "circumoral buttresses;" they extend in the form of four free mesenteric lamellæ from the four perradial angles of the œsophagus to the middle of the subumbral wall of the radial pouches, and are best described as reproductive folds or genital mesenteries (" mesogonies "). The four depressions lined with the ectoderm of the subumbrella are the funnel cavities (" infundibula," figs. 2, 6, *ii*). The cæcal ends of these conical or trigonal pyramidal hollow spaces penetrate from the coronal cavity of the umbrella deep into the central gastral cavity, and have occasioned many misapprehensions. Clark calls them "circumoral pouches," Taschenberg " genital pouches," Kling " pyramidal spaces," and Hertwig " intergenital pouches." As these funnel cavities are only lined by the ectoderm and have no connection with the gastrovascular system, but belong much more to the system of the subumbral umbrella cavity, they cannot be termed " pouches " but merely " cavities." They recur in the same way in many other Acraspedæ as " subgenital cavities." In our *Lucernaria* they penetrate so deep into the central gastral cavity as to divide its oral half into four perradial peripheric niches, or " central chambers." The conical funnel cavities between the latter are separated from them by the gastral filaments, and pass directly above into the solid tæniola (fig. 21, *ft*).

The muscular plate of the subumbrella lies immediately under the ectodermal epithelium, from which it is secreted, and consists of a marginal octomeral coronal muscle and of eight separate radial muscles. The coronal muscle ("musculus coronarius"), or circular muscle of the umbrella margin, is homologous with the simple marginal circular muscle of the Tesseridæ and with the large octomeral coronal muscle of the Pericolpidæ, which in the Periphyllidæ is divided into sixteen muscular areæ. The coronal muscle in the eight-armed Lucernaridæ, as in the closely-allied eight-lobed Pericolpidæ, consists of eight separate areæ, the eight " marginal muscles," of which four longer (figs. 2, 3, 12, *mm'*) lie in perradial octants, four shorter (*mm''*) in four interradial octants; as, however, the eight arms (or marginal lobes) are adradrial, each coronal muscular area (or each marginal muscle) applies to the two halves of each two adjacent arms turned to each other. It extends on their external or abaxial side, and that of the tentacles running out from them. The separate bundle of muscles, which here pass into the tentacles, therefore extend them and make them arch outwards (" extensores"). If, on the other hand, all the eight marginal muscles contract simultaneously, they narrow the umbrella opening like the simple circular muscle of the Tesseridæ. The coronal muscle is, moreover, in all Lucernaridæ much narrower than in the Pericolpidæ, and has the form not of a broad band, but of a thick cord. In our species this cord shows six to eight deep parallel furrows, divided from each other by the same number of circular folds (fig 20 in radial transverse section). The height of these folds increases from above downwards (from the proximal to the distal margin of the marginal muscle).

Each fold is formed by an elevation of the supporting lamella (*z*), which again forms secondary folds, and therefore appears dendritically branched in transverse section. The circular fibres of the muscular plate (*m*) cover this system of folds connectedly; and are covered in their turn by the ectodermal epithelial cells of the subumbrella (*qw*) from which they are secreted. The eight longitudinal deltoid muscles (figs. 2, 3, 4, 12, *md*) work antagonistically to the eight circular marginal muscles. In the deltoid muscles of our species the four perradial (*md'*) are very weak but very broad, whilst on the other hand the four interradial (*md''*) are much narrower, but proportionately more strongly developed. These appear to be the direct processes of the strong tæniola muscles, they run along the entire length of the septa of the pouches (fig. 12, *tr.s*), and split up below at the distal end of the latter, into two strong limbs (fig. 12, *md'''*) each of which bears a bunch of tentacles.

The umbrella margin has eight shallow concave depressions or "marginal sinuses," between which, as in all Lucernaridæ and Pericolpidæ, lie eight adradial marginal lobes. These eight adradial hollow marginal appendages, which have hitherto been generally termed "arms" in the Lucernaridæ and erroneously considered a special peculiarity of this family, are, in fact, from their situation, structure, and signification, merely the eight adradial marginal lobes of the closely allied Pericolpidæ and as such homologous to the eight sense lobes (or "eye lobes") of the Periphyllidæ. The essential difference from the Pericolpidæ, which is strikingly displayed by the Lucernaridæ, is that each of the marginal lobes or "arms" bears a brush-shaped bunch of numerous small, hollow knobbed tentacles at their points. Morphologically considered, these tentacles belong to the category of accessory or secondary tentacles, and are merely long-stalked urticating knobs. On the other hand the four principal tentacles of Tessera (four primary perradial and four secondary interradial) have disappeared in the genera *Lucernaria* and *Craterolophus*, whilst in *Haliclystus* and *Halicyathus* they are transformed into adhesive "marginal anchors." In our species the eight arms are very small, and less developed than in most other Lucernaridæ; they project only slightly from the umbrella margin as broad triangular points and are placed together in pairs, so that the four perradial sinuses of the umbrella margin are three times as large as the four interradial (figs. 1–4). Each short arm or marginal lobe bears a bunch of from 80–120 tentacles.

All the tentacles (Pl. XXII. figs. 15, 16) are completely fused together at their basal halves, so that only their distal halves are free and movable (fig. 15). They are cylindrical, 2–3 mm. long, when contracted (probably twice as long when extended), and nearly ½ mm. thick. As in all true Lucernaridæ, they are hollow, thick-walled little tubes, whose cæcal and somewhat thinner distal end bears a thicker urticating knob. This stalked urticating knob in our species is developed into a strong sucking-cup, with a depressed sucking-pit in the middle (fig. 16, *x*). The hollow cylindrical epithelium of the ectoderm (*q*) is four to six times as high in the sucking-cup as on the tentacle stalk, and has a peculiar construction, which however could not be more minutely investigated as the tentacles were not sufficiently well preserved. The ectodermal cells in the central sucking-pit are much flatter, and without nematocysts (fig. 16, *x*). The muscular plate, consisting of strong longitudinal fibres (*m*), lies immediately under the ectoderm (*q*). Then comes a thick gelatinous supporting plate, which acts as elastic extensor against the pull of the longitudinal muscular fibres, and re-extends the contracted tentacles, shortened by the latter. In the sucking-cup the gelatinous fulcral lamella forms a peculiar thick cap (fig. 163'), which encloses the cæcal end of the tentacle canal and is sharply divided by a distinct boundary line (*z''*) from the thinner gelatinous plate of the peduncle (*z'''*). The endoderm (*d*) forming the epithelium of the tentacle canal (*ct*), consists of high, dark-brown pigmented cylindrical cells, having numerous unicellular glands distributed among them. The cæcal distal end of the tentacle canal shows a very peculiar condition unknown to me in any other Lucernarid. The end of the canal is closed by a conical wedge, which completely fills the distal end of the lumen of the tube and is enclosed by endoderm. This axial wedge of the sucking-cup (fig. 16, *y*) dyes a much more intense dark red with carmine than any other part of the tentacle. It contrasts sharply with the yellow-brown endodermal cells enclosing it, and seems composed of roundish corpuscles, thickly pressed together, which refract light strongly and look like nematocysts. This axial wedge of the sucking-cup perhaps serves as a firm support during its adhesion.

The formation of the gastrovascular system (Pl. XVI. figs. 2–7; Pl. XVII. figs. 13–16) does not differ essentially in our *Lucernaria* from that known in other species of this genus; it lies between the simpler formation of the Tesseridæ (Pl. XV.) and the more developed formation of the Periphyllidæ (Pls. XVIII.–XXII.). As in the Tesseridæ it is divided into a central principal intestine ("gaster principalis"), and a peripheric coronal intestine ("gaster coronalis"), communicating by four perradial gastral openings (*go*). The principal intestine consists of three parts, viz., the aboral basal stomach in the peduncle, the central stomach, and the freely projecting buccal stomach or œsophagus. The central stomach is separated from the basal stomach by the pyloric opening ("pylorus"), and from the buccal stomach by the palatine opening ("palatum"). The basal stomach ("gaster basalis," *gb*) is the peduncle canal already mentioned; it passes through the entire length of the peduncle, and ends cæcally in its oral basis, whilst it opens at the oral peduncle end by the pylorus (*gy*) into the central stomach. The basal stomach originally presented a simple cylindrical or quadrangularly prismatic hollow space, corresponding to the "apical canal" of the Tesseridæ. As the four interradial tæniola (*ft*) project from the wall of the peduncle into the stomach, they divide its periphery into the four perradial peduncle grooves or half canals already described (fig. 13, *cp*). In this way the basal stomach acquires in transverse section the characteristic regular cross shown in fig. 13, Plate XVII. The central stomach ("gaste centralis") has usually a conical or quadrangularly pyramidal shape, and opens with the truncated aboral end into the peduncle stomach by the pyloric opening ("pylorus," *gy*) and with the quadratic, strongly constricted oral basis into the buccal stomach by the palatine opening ("palatum," *gp*). Four perradial clefts, the gastral openings ("ostia gastralia," figs. 2, 3, *gp*; fig. 21, *go*) lead from the central stomach into the four radial pouches. As the four conical interradial funnel cavities (*ii*) already described project arch-like between the four gastral openings into the central stomach, the formation of the latter becomes rather complicated. Both margins of the cleft-shaped gastral openings are edged nearly their whole length by a row of fine gastral filaments (fig. 21, *f*); these are only wanting on the lower (oral) fourth of the gastral openings where their margin forms the cartilaginous-like thickened groove of the palate (fig. 21, *gs*). The rows of filaments or phacelli run above to the point of the funnel cavities, but do not pass on to the solid tæniola. In comparison with other Lucernaridæ, and with the considerable size of our species, its filaments appear slightly developed, very fine and rather short; they are limited here to the lateral margin of the gastral openings, whilst in other species they often extend distally far on to the lateral margins of the genitalia, or proximally on the basal tæniola. Like the filaments, the œsophagus or "buccal stomach" seems only slightly developed in *Lucernaria bathyphila* (proboscis, figs. 2–4, *ga*). It forms a low, fleshy, membraneous border, quadrate in outline, which only projects slightly from the palatine opening into the umbrella cavity. The thickened glandular margins of the oral opening are only slightly frilled (fig. 9). The four perradial angles of the œsophagus pass at the palatine opening, into the four subumbral mesogonial folds (*wz*).

The peripheric coronal intestine ("gaster coronaris"), which only communicates by the four perradial gastral openings with the central stomach, in *Lucernaria bathyphila* is formed (owing to the slight development of the eight arms) almost exclusively by the four voluminous radial pouches ("bursæ radiales," *bp*) which Clark termed "quadrant chambers," Keferstein "broad pouch-shaped radial vessels," Taschenberg "radial canals," Kling "radial chambers," and Hertwig "radial chambers or radial pouches." These present four flat pouch-like hollow spaces extending between the umbrella and subumbrella to the umbrella margin. They are only divided by four interradial "septal selvages," or "lines of fusion," linear septa in which the umbrella is fused with the subumbrella ("septa cathammalia," *ks*). As this fusion does not, however, extend as far as the umbrella margin, the four pouches communicate there below the distal end of the septa, by four interradial circular openings, so that a circular communication, a sort of "circular canal," is formed on the umbrella margin (fig. 12, *cc*). The proximal half of the four radial pouches opens by the gastral openings into the central stomach; whilst eight lobe pouches or "arm pouches" ("bursæ lobares") run from its distal margin into the eight arms. The end of each lobe pouch again sends out a tentacle canal into each tentacle (figs. 15–16, *ct*). As the eight arms or marginal lobes in our species project only slightly above the umbrella margin, their lobe pouches (*bl*) never reach an independent development. The development is consequently proportionably greater of the four radial pouches, whose length is nearly two-thirds that of the whole length of the umbrella, and only partially occupied by the conspicuous genitalia, lying in their subumbral wall (comp. figs. 2–7, *bp*).

The genitalia (Pl. XVI. figs. 2–7, *s*, figs. 10, 11; Pl. XVII. figs. 17–19, 21). The specimen examined was a mature female, and showed most distinctly that the ova in the Lucernaridæ (as in all Stauromedusæ) are developed from the endoderm of and in the subumbral wall of the radial pouches, then fall into their cavity, reach the central stomach through the gastral openings, and are finally expelled through the mouth; all parts of the gastrovascular system of the uninjured Medusa contained when opened numerous, loose, ripe ova. The ovaries (figs. 2, 3, *sf*) form eight broad plates occupying the greater part of the subumbral wall of the four perradial gastral pouches, and are distributed in pairs in such a manner that the two genitalia separated by an interradial septum, form a connected pair. The two ovaries lying in one and the same radial points, therefore form two different pairs (comp. my System der Medusen, 1879, p. 386). The interradial interval between each two reproductive leaves is considerably smaller than the perradial interval; their distance from the distal margin of the four radial pouches is also much less than from the proximal margin (comp. figs. 2, 3, *sf*). Their outline is semi-oval or almost lanceolate, and broadened in the distal third.

The structure of the ovaries in *Lucernaria bathyphila* is very peculiar, and more complicated than in all other Stauromedusæ hitherto known. Even with the naked eye the upper surface of the eight reproductive glands appears granular as if paved, and a slight magnifying power (fig. 21, *sk*) shows that each genitalium is composed of a large number (nearly 200–250) of entirely separate sacs. These have an irregular roundish or polygonal outline, averaging 1 mm. in diameter (the smallest rather under ½ mm., the largest rather above 1½ mm.). Whilst in all other Lucernaridæ hitherto known these reproductive sacs ("sacculi genitalis," *sk*) represent simple glands with a single hollow space and excretory passage, in our deep-sea species they are lobed glands composed of several separate lobes or follicles, each having its own cavity and its own excretory passage. Each separate sac (fig. 10, seen from the surface, fig. 18, in perpendicular longitudinal section) is therefore usually composed of from thirty to fifty follicles (*sb*). Each separate follicle (fig. 11 from the surface, fig. 19 in longitudinal section) contains a "sinulus" (*sc*) or secondary cavity, which opens by a "ductulus" or secondary excretory passage (*sl*) into the "sinus genitalis," or principal cavity of the sac (fig. 18, *sc*); the last opening by its ductus or principal excretory passage (*sl*) into the radial pouch (*sa*). The ova (fig. 19, *so*), which are developed from the endodermal epithelium of the follicle, pass first from its sinulus (*sc*) into its ductulus (*sl*), thence into the sinus of the sacculus (fig. 18, *sc*), and from the sacculus by the ductus (*sl*) into the radial pouch. The ovary of

Lucernaria bathyphila, therefore, furnishes the first example in the order of Stauromedusæ of a complicated reproductive gland with lobed sacs and branched hollow spaces; and this, and other peculiarities already mentioned of our deep-sea species, justify its being raised to the type of a separate species, *Lucernosa*. Both the separate sacs and the follicles of which they are composed are enclosed in a thin structureless "membrana propria," a direct process of the gelatinous fulcral plate of the subumbrella. The sacs (figs. 17, 18, *sk*) project freely from the subumbral wall of the radial pouches, on whose endodermal surface they are placed, into the hollow space of the pouches; their free abaxial surface is covered by the ciliated endodermal pouch epithelium, whilst their fixed axial surface is divided from the ectodermal pouch epithelium (*qw*) by the thick gelatinous plate of the subumbrella (figs. 17, 18, *ug*). There is, therefore, no doubt that the ova are developed from the endodermal cells of the sacs, which has no connection with the subumbral ectoderm.

Order VI. PEROMEDUSÆ, Hæckel, 1877.

Acraspedæ with four interradial rhopalia, containing an auditory club with an endodermal otolite sac and one or more eyes, four perradial tentacles or twelve tentacles (four perradial and eight adradial), eight adradial or sixteen subradial marginal lobes. Stomach surrounded by a subumbral coronal sinus, whose division into four radial gastral pouches is only indicated by four small interradial septal nodes; eight or sixteen coronal pouches on the distal margin of the coronal sinus; two lateral lobe pouches from each coronal pouch, and in the middle between the lobe pouches, a pouch for the tentacle or the rhopalium. Genitalia, eight adradial horseshoe-shaped swellings which lie in the subumbral wall of the coronal sinus, are developed from its endoderm and partly project into its cavity.

Family, PERIPHYLLIDÆ, Hæckel, 1877.

PERIPHYLLIDÆ, Hæckel, System der Medusen, 1879, p. 415, plate xxiv.

Peromedusæ with twelve tentacles (four perradial and eight adradial), with four interradial rhopalia and sixteen subradial marginal lobes (eight tentacular and eight ocular). Exumbrella with sixteen pedalia, and a coronal muscle with sixteen coronal areæ (four perradial, four interradial and eight adradial), a coronal pouch between each pedalium and each coronal area. Marginal festoon canal formed of thirty-two lobe pouches.

Sub-family, PERIPHEMIDÆ, Hæckel, 1880.

Periphyllidæ whose four interradial funnel cavities are not limited to the central stomach but also traverse the basal stomach, wholly or partially.

Periphylla,[1] Steenstrup, 1837.

Periphyllidæ with four perradial buccal pouches of the œsophagus and four perradial completely separated niches of the basal stomach. Between these niches, the four subumbral funnel cavities (or the four hollow interradial tæniola of the basal stomach) form hollow cones, which are beset along their whole length by two rows of gastral filaments and touch each other above in the point of the cone.

The genus *Periphylla*, as well as the following closely allied genus *Periphema*, was only presented in the Challenger collection by a single specimen. However, its large size and its excellent state of preservation enabled me to examine it more minutely and thoroughly than I had ever been able to examine any other *Peromedusa*. So that the following description of *Periphylla mirabilis* with the six plates (XVIII.–XXIII.) may be accepted as a firm foundation for the anatomical knowledge of the whole order of Peromedusæ. This conspicuous and remarkable group of Acraspeda was, till lately, almost unknown. On the one hand, it keeps in many ways the primitive formation of the Stauromedusæ, and is more closely connected both with the Tesseridæ and the Lucernaridæ than the two orders of Cubomedusæ and Discomedusæ, especially with regard to the remarkable formation of the central gastrovascular system. On the other hand, it is raised so far above the other three orders of Acraspedæ by the peculiar complication of its anatomical structure, and specially by complicated formation of the pouches, that in many respects it may be called the most highly developed of all Medusæ. At any rate, we must consider them as an independent principal group, as a special "order" of Acraspedæ, which have no direct connection with the Cubomedusæ and Discomedusæ, but must be rather regarded as a peculiarly developed branch of the Stauromedusæ. All that was known of the wonderful Peromedusæ up to the year 1879 was limited to the imperfect description of three different species of the genus *Periphylla*. But two of these figures showed only the empty umbrella of the dead animal without any internal organs—*Charybdea periphylla*, Péron and Lesueur (1809); and *Charybdea bicolor*, Quoy and Gaimard (1833). The description of the third species, *Dodecabostrycha dubia*, Brandt (1838), is partly good, partly very erroneous and incomplete, and remained to be completely unintelligible. Detailed examination of several well-preserved specimens of the stately *Periphylla hyacinthina* and some other smaller species made by me on the genera *Pericolpa*, *Pericrypta*, and *Peripalma* first enabled me, in 1879, to describe more minutely the hitherto unknown organisation of the Peromedusæ, and to place them as an independent order of the class (in the System der Medusen, pp. 396–422, Pls. XXIII., XXIV.). The anatomical description given there will, however, be enlarged and completed in many points by the following more detailed anatomy of *Periphylla mirabilis*. This species, as well as the following species, *Periphema regina* belong to the family of the Periphyllidæ, these large and highly organised Peromedusæ which have twelve tentacles, sixteen marginal lobes, and thirty-two lobe pouches. Contrasted with these stand the older and more simply constructed Pericolpidæ, which are more closely connected with the Lucernaridæ, and have only four perradial tentacles, besides eight marginal lobes, and sixteen lobe pouches. Each perradial tentacle of the Pericolpidæ is represented in the Periphyllidæ by three tentacles, and two marginal lobes inserted between them. All Peromedusæ have invariably only four interradial rhopalia, and this alone distinguishes them from all other Medusæ. Our *Periphylla mirabilis* is distinguished from all other species of the genus by the eight strong barbous filaments of the margin of the mouth, and may therefore be regarded as the representative of a distinct genus—*Periphenga mirabilis* (*περιφέγγα*, radiating).

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[1] Περιφύλλα=set round with leaves.

Periphylla mirabilis, Hæckel (Pls. XVIII.–XXIII.).

Periphenga mirabilis, Hæckel, 1879, System der Medusen, p. 422, No. 424.

Umbrella conical, about one-fourth higher than broad. Pedal zone of the exumbrella somewhat higher than the lobe zone, both together nearly three-fourths as high as the cone zone. Marginal lobes oval, pointed; their distal wings triangular, half as high as their proximal gelatinous swelling. The eight tentacle lobes projecting less than the eight rhopalia lobes on the umbrella margin. Tentacles twice as long as the height of the umbrella, one-third as broad as the marginal lobes at their basis. Œsophagus cubical, one-third as high as the umbrella, reaching only to the coronal muscle, with eight adradial, long, feathered, barbous filaments at the margin of the mouth. Horizontal diameter, 120 mm.; vertical diameter, 160 mm.

Habitat.—South Pacific Ocean, near the east coast of New Zealand. Lat. 40° 28′ S., long. 177° 43′ E. Station 168. The single specimen captured, a mature male, was taken July 8, 1874, at a depth of 1100 fathoms. It was admirably preserved in spirit, was quite perfect; and was, on the whole, of a pale violet colour. The inner or endodermal surface of the gelatinous umbrella was overlaid with dark, violet-brown pigment, which was easily rubbed off, and consisted of small roundish granules in the endodermal cells of the abaxial wall of the gastral space. The tentacles appeared coloured darker violet, the genitalia reddish-yellow. After lying some years in spirit, the colours become fainter.

The umbrella (Pl. XVIII. fig. 1; Pl. XIX. fig. 6; Pl. XX. fig. 8; Pl. XXI. figs. 12–20) of *Periphylla mirabilis*, as of most other Peromedusæ, is high-arched, conical, pointed above, and widened like a funnel below, or almost helmet-shaped. The height (or vertical diameter) of the umbrella—including the marginal lobes, excluding the tentacles—amounted in the uninjured specimen to 16 centimetres; therefore, one-fourth more than the breadth at the opening of the umbrella, 12 centimetres being the largest horizontal diameter. Almost in the middle of its height,—8½ cm. from the umbrella cone, 7½ cm. from the umbrella margin, the umbrella is deeply constricted by a horizontal circular furrow, the coronal furrow ("fossa coronaris," *ec*). The umbrella cone or "cone zone" ("zona conaris") is a perfectly simple smooth cone, pointed above and widening symmetrically below; its firm, gelatinous substance is of nearly equal thickness throughout, about 8 mm.; in the coronal furrow (*ec*) its thickness suddenly diminishes to 2–3 mm. (fig. 35). The external surface of the cone is flat throughout without any ornament. The corona of the umbrella, on the contrary, is subdivided by a lower horizontal circular furrow into two zones, the upper pedal zone and the lower lobe zone. The pedal zone ("zona pedalis") is divided by sixteen deep longitudinal furrows into the same number of projecting wedge-like gelatinous socles, the pedalia. Of these the four interradial are considerably smaller (25 mm. high, 12 mm. broad above, and only 8 mm. below), and bear below the four sense clubs and their ocular lobes ("pedalia ocularia"). The twelve remaining gelatinous socles ("pedalia tentacularia") bear the tentacles and their lobes below, and are much larger (35 mm. high, 13 mm. broad above, 17 mm. below). Between each two interradial ocular pedalia (fig. 19, *ni*) there are three larger tentacular pedalia, the central one (*up*) lying perradially, the two lateral (*ua*) adradially, (comp. figs. 18 and 19). The firm gelatinous substance of the umbrella is 10–12 mm. in thickness in the upper part of the pedalia, whilst in their lower part it is diminished to 3–5 mm. Each pedal is limited on the upper convex margin by a crescentic area ("areola semilunaris") (fig. 34, *xs*), which is divided by 8–10 small shallow longitudinal furrows into the same number of smaller swellings ("gyruli"); they end above in the bottom of the large coronal furrow, and contain pointed processes of the exumbral zonal muscle (fig. 34).

The exumbrella of the corona of the umbrella in our *Periphylla*, as probably in all Peromedusæ, is distinguished, not only by the longitudinal and transverse furrows already mentioned, which penetrate more or less deeply and are connected with important internal anatomical and ontogenetic conditions of organisation, but also by special exumbral muscles. In the deep coronal furrow between the umbrella cone and umbrella corona ("fossa coronaris," *ec*) there is a ring-shaped external zonal muscle ("musculus zonaris," *mz*), with sixteen exumbral points projecting from its distal margin; these are triangular, having the point directed downwards and correspond to the radii of the marginal lobes; they consequently lie subradially, and their distal end passes below in the furrow, between the two pedalia in whose prolongation the lobe clasp (fig. 34, *mz*) is placed. Both the zonal muscle itself and the muscular points proceeding from it are composed of strong annular fibres.

The true umbrella margin (in the wide sense) ("margo umbralis," *um;* Pl. XVIII. fig. 1; Pl. XIX. fig. 6; Pl. XX. fig. 8; Pl. XXII. fig. 22) is formed by the lobe zone of the umbrella corona already mentioned, and consists of the following important organs:—four interradial sense clubs, twelve tentacles (four perradial and eight adradial), and sixteen subradial marginal lobes, inserted between the former and the latter. These organs in all Peromedusæ, show very peculiar and complicated conditions of structure, which thoroughly distinguish them from both the Stauromedusæ and the Cubomedusæ. Notwithstanding, these structures are phylogenetically derived from those of the Stauromedusæ and then from those of the Pericolpidæ (comp. my System, 1879, taf. xxiii.). The four perradial tentacles and their four interradial sense clubs have arisen from the eight principal tentacles of the Tesseridæ, and are therefore homologous with the "marginal anchors" of the Lucernaridæ; on the other hand the eight adradial tentacles with the alternating marginal lobes of the Pericolpidæ, are homologous with the hollow arms of the Lucernaridæ. The umbrella margin of the Periphyllidæ has plainly arisen in this way from that of the Pericolpidæ, as instead of each perradial tentacle, there are three tentacles with two additional marginal lobes between them. The number of tentacles rises in this way from four to twelve, and the number of the marginal lobes from eight to sixteen. The original number of the four sense clubs remains invariable in all Peromedusæ, and is typical of the whole order.

The sixteen marginal lobes ("lobi marginales," Pl. XVIII. fig. 1; Pl. XXII. fig. 22; Pl. XXIII. figs. 29–32) of the corona of the umbrella are, on the whole, egg-shaped, lie subradially in the meridian plane of the fourth order, and are divided into four pair of ocular lobes (*lo*), and four pair of alternating tentacular lobes (*lt*). The two ocular lobes ("lobi oculares") of each umbrella quadrant lie exradially, as the interradial eye is set between them. The marginal incision between them up to the eye is 17 mm. deep, half as deep as the incision between each ocular lobe and the neighbouring tentacular lobe. The two ocular lobes of each pair therefore compose a broadly oval, ocular principal lobe, whose free margin is divided into two secondary lobes (fig. 1). Each ocular secondary lobe is divided by a deep longitudinal furrow into two halves, an adocular and an exocular. The exocular or external half, which touches the adradial tentacle, is wing-shaped and thinned, and runs into a delicate membranous selvage in the margin of the lobe ("patagium," *lp*). The inner or adocular half, which touches the interradial eye, is strongly thickened, so that in conjunction with that of the adjacent secondary lobe, it forms a thick swelling, projecting convexly outwards, in direct prolongation of the ocular pedalium (*ur*). Each ocular principal lobe therefore appears like a broad oval leaf, which has a midrib 1 cm. broad, side-wings 3 cm. broad, and is 4 cm. long in all (in the middle line). The two tentacular lobes ("lobi tentaculares") of each quadrant of the umbrella lie coradially, as they enclose the perradial tentacle beween them and are divided externally from the ocular lobes by the adradial tentacle. Each of the two tentacle lobes represents a longish oval leaf 4 cm. long and 2 cm. broad, divided by a deep subradial longitudinal furrow into two lateral swellings; this furrow forms the direct process of the coradial furrow, which separates the adradial pedalia of the furrow zone from the perradial. Each of the two swellings of each tentacular lobe is almost linear. A very thin, folded, wing-shaped membranous selvage ("patagium," *lp*), 5–8 mm. broad, also runs round the margin of this lobe; it is broadest at the point and narrowest at the base (fig. 1, 22, &c.).

The fused clasp of the marginal lobes ("loboporpa, cathamma lobare," *kl*; Pl. XXII. fig. 22; Pl. XXIII. fig. 29). The exumbral longitudinal furrow of each lobe, which divides its two gelatinous swellings and passes above into the "sulcus interpedalis," has a corresponding fused clasp (*kl*) in the interior of the lobe. This is a rectilinear gelatinous selvage of cartilaginous hardness, firmness, and elasticity. It springs with a broad basis (fig. 29, *kl*) from the proximal margin of the coronal muscle, and reaches the border of the middle and distal third of the lobe, where it becomes thicker and ends (fig. 22, *kl''*). Its peculiar structure is shown in Plate XXV. fig. 10, under a higher magnifying power. The clasp is formed by the umbral or abaxial endodermal epithelium (fig. 10, *dw*) and the subumbral or axial endodermal epithelium (fig. 10, dw_2) becoming fused into sixteen subradial straight lines in the peripheric part of the circular sinus, by which the latter is divided in the region of the coronal muscle into sixteen coronal pouches (*bc*). The fused clasp of the marginal lobes completely divides the two adjacent coronal pouches, but only partially divides the lobe pouches proceeding from them (Pl. XXV. fig. 10, *bl*), which are bent into each other like a horse-shoe at the thickened distal end of the clasp (*bu*, figs. 22, 29). Both the thicker gelatinous plate of the umbrella (Pl. XXV. fig. 10, *ug*) and the thinner gelatinous plate of the subumbrella (*zw*) undergo considerable induration and peculiar histological change in the region of the fusion of the two layers of endodermal epithelium. The soft gelatinous substance becomes a firm fibrous cartilage with numerous roundish cells separated by a fibrillar intersubstance. The fibrous cords of the intercellular substance cross each other in all directions, as they do in the analogous cathamma of the nodes of the septa (Pl. XXV. fig. 4, *kn*).

The sixteen tentacles (Pl. XXVIII. fig. 1; Pl. XIX. figs. 6, 7; Pl. XXI. fig. 21; Pl. XXII. fig. 22) are strong, hollow cylindrical tubes, which gradually decrease conically towards the distal point. All the twelve tentacles (four perradial, eight adradial) are of equal size. They are from 30–40 cm. long, consequently twice the height of the umbrella; they are possibly 50–60 cm. long in the living animal. The tentacles are 8 mm. thick at their enlarged conical bases; 3 cm. below the insertion they are 5 mm. thick; 5 cm. below only 3 mm., and so gradually decrease towards the point which runs out almost to a thread. The smooth upper surface of the cylindrical tube appears repeatedly constricted by numerous annular folds, which are only interrupted by the longitudinal muscles (figs. 1, 6, 7). The spacious cavity of the tentacles is enclosed by a thin but very firm leather-like wall.

The tentacle wall is formed of four layers (Pl. XXI. fig. 21):—(1) the endodermal epithelium (*d'*) of the canal (*ct*); (2) the supporting plate (*z*); (3) the muscular plate (*m*); (4) the ectodermal epithelium of the outer surface (*q*). The finer structure of the wall is very peculiar, but could not be diagnosed satisfactorily from the only spirit-specimen examined. The ectodermal epithelium (*q*) contains numerous nematocysts. The muscular plate (*m*) appears thinned away on both lateral surfaces of the tentacles, but on the other hand thickened so remarkably on the inner and outer side that it projects in the form of two strong band-shaped longitudinal muscles. The external or axial longitudinal muscle springs from the pedalia, and usually occupies only the proximal third or fourth of the length of the tentacle. The inner or axial longitudinal muscle runs through the entire length of the tentacle, and is split up above into two conical root muscles (*mk*, figs. 22, 29). These invaginate the distal margin of the corresponding coronal pouch, divide it into an external velar pouch and an internal avelar pouch, diverge into the "funnel of the tentacle" (*it*), formed in this way between the velar and avelar pouches and run as the proximal margin of the coronal muscle, where they are inserted (comp. below). If the internal longitudinal muscle is strongly contracted, the tentacle appears rolled up spirally and laid in deep transverse folds (*d*). A structureless thin, but very firm, supporting plate ("lamina fulcralis," fig. 21, *z*) lies under the muscular plate (*m*) and under the supporting plate, the endodermal epithelium of the tentacle canal (*d*). The nature of the latter is very remarkable; it consists of large vesicular cells, and rises in the shape of a thick spongy cord (fig. 21, *d''*) on the abaxial side of the canal wall. This cord consists of an accumulation of very large vesicular cells, and fills like marrow nearly the half of the lumen of the tube (*ct*). It would require to be more minutely investigated in living and well-preserved animals. So would another most peculiar arrangement of the tentacles; a strong, double-valved aperture lying inside the base of the tentacle immediately at the point where the tentacle roots diverge (Pl. XXII. fig. 22, *yk*). The elastic fulcral lamella is swollen there into a thick gelatinous plate containing cells, and forms two horizontal vent-valves lying above one another, by means of which the cavity of the tentacle can be completely closed. Even by strong pressure from within the tentacle cavity it was impossible to overcome the antagonism of the double valve. The cavity of the vent-hole (fig. 22, *cx*) between the distal (*yk''*) and the proximal valve (*yk'*) is nearly as high as broad.

The marginal sense clubs ("rhopalia") of *Periphylla* (Pl. XVIII. figs. 1–5; Pl. XXII. fig. 22, *or*; Pl. XXIII. 31, 32, *or*) have been already described by me in *Periphylla hyacinthina* in my System der Medusen (1879, taf. xxiii. figs. 9–12). They appear to have essentially the same formation in *Periphylla mirabilis*, and represent very composite organs of sense connected among the forms hitherto known, with the rhopalia of the Cubomedusæ on the one side and with those of the Nausithoidae on the other. As in all Peromedusæ there are only four interradial rhopalia, which lie in the radii of the septal nodes and the tæniola. They were, unfortunately, very badly preserved in the spirit-specimen examined; a complete and correct insight into their very complicated minute structure could only have been obtained by examination and special preparation of fresh rhopalia.

With the naked eye they can be recognised as white granules in the incision between the two ocular marginal lobes. Each rhopalium consists of a conical basal part, the sense knob, of a large sense vesicle on the axial side of the knob, and of a sense fold or protective scale which is placed at the distal end of the sense knob and surrounds the auditory club as well as the eye (comp. Pl. XVIII. fig. 2, seen from the inside, axial side; fig. 3, seen from outside, abaxial side; fig. 4, seen in profile; fig. 5, seen half from the inside, half in profile). The sense knob corresponds to the basal part of the greatly shortened and thickened tentacle, from which the whole sense club is phylogenetically derived. It projects between the bases of its two constituent sense lobes, is usually conical in shape, and bears the large spheroidal or oval sense vesicle ("ampulla rhopalaris," *oa*), a cæcal arching outwards of the sense pouch (*bo*) on its inner or axial side. Just under the ampulla the sense knob is constricted like a neck and surrounded by the large, darkly pigmented sense collar (*op*). The latter forms an ectodermal swelling, with a thick accumulation of brown or dark pigment and has quite the shape of a high coat collar, which closes round the neck of the sense knob on the abaxial (external or dorsal) side, whilst it falls obliquely on the axial (inner or ventral) side, and passes into two lateral symmetrically-placed lapels (figs. 2, 3, *op*). The two lapels of the sense collar are divided from one another by a deep, broad furrow, which is only bridged over below at the distal margin of the collar by a narrow cross bar of pigment. An unpaired axial eye with lens (*oc'*) and pigment cup appears to lie in the depth of the furrow between the end arms and the pear-shaped auditory club (*ok*), the distal end of the acoustic tentacle rises on a thin stalk immediately below it. The auditory club is white, and consists of an axis of endoderm cells, the last of which forms a large spheroidal otolite sac, closely filled with numerous small prismatic crystals (*ol*). The ectodermal covering of the auditory club bears auditory hairs which project freely into the niche of the auditory scale (*os*). The latter forms a protective scale, oval or triangular in shape, arched convexly outwards, concavely inwards, so that it surrounds the auditory club as a protection from the abaxial (external) and distal (lower) side. Two eyes containing a planconvex or biconvex lens in the midst of a cup of brown or black pigment (?) appear placed inside the niche of the scale (*on*) on the abaxial side of the auditory club (between the otolite sac and the sense collar). All these conditions could, unfortunately, only be indistinctly and incompletely recognised in the poorly-preserved spirit-specimen, so that it was only by aid of comparison with the sense clubs of some other *Periphylla* that I was able to draw out figures 2–5 reproduced in Plate XVIII., which can only claim to be approximately or even remotely correct. It may, however, be safely asserted that the sense clubs of *Periphylla* are modified interradial tentacles, which function simultaneously as acoustic and as optical organs of sense; in some respects they appear allied more with the sense clubs of *Charybdea*, in other respects with those of *Nausithoe*. In our species there are probably three small eyes furnished with pigment, lens and nerves above the auditory club; of these the unpaired (lower) eye looks inwards, the two paired (upper) eyes outwards.

The nervous system of *Periphylla*, like that of all the Peromedusæ, is at present unknown, and, unfortunately, in spite of repeated efforts, I was unable to make it out from the single spirit-specimen examined. It requires fresh researches on living and specially-prepared material. But considering the high stage of differentiation and perfection to which the formation both of the muscular system and of the sense organs of our highly developed Medusa has attained, we may assume that the nervous system is also fully developed. This supposition is further justifiable from the fact that the closely-allied Cubomedusæ have a highly developed nervous system with centralised nerve ring, and that the organs of sense show many analogies in the two orders. A nerve ring probably runs in the coronal furrow as an important central organ, in immediate connection with the four interradial sense clubs. A second nerve ring perhaps exists at the margin of the coronal muscle, and possibly a third at the oral margin or the palatine ring. From the large size of this Medusa, these important conditions might be explained by examination of more perfectly preserved *Periphylla* treated with osmium and other such reagents.

The subumbral umbrella cavity ("antrum," Pl. XIX. fig. 6; Pl. XX. fig. 8; Pl. XXI. figs. 12–19) in our *Periphylla*, as in all Peromedusæ, is divided into two distinct sections, the distal simple coronal cavity and the proximal quadrilocular funnel cavity, the palatine ring forming the boundary of the two. The distal (lower or oral) coronal cavity of the umbrella ("antrum coronare," fig. 19, *hc*) is simple, shaped on the whole like a hemisphere or truncated cone, and enclosed round by the corona of the umbrella; it is 7 cm. in height by 12 cm. in diameter, opens below to the outside by the opening of the umbrella and contains the œsophagus in its centre. The upper boundary of the coronal cavity against the funnel cavity is formed by the palatine ring ("annulus palatinus," *wp*). I give this name to the important subumbral boundary ring between the œsophagus and the coronal sinus, in whose plane the four perradial palatine nodes are inserted into the wall of the sinus. Four wide horizontal openings, the funnel openings ("ostia infundibularia," fig. 18, *if*), leading from the coronal opening of the umbrella into the four interradial funnel cavities (*ii*), are placed between the four palatine nodes.

The funnel cavities ("infundibula") are conical ectodermal invaginations of the subumbrella into the central stomach. They correspond completely to the "funnel cavities" of the Lucernaridæ, but are much more strongly developed, and play a much more important part. Whilst in *Pericolpa* and *Peripalma* they only reach the boundary of the central stomach and basal stomach (as far as the pyloric ring), in *Pericrypta* and *Periphylla* they completely hollow out the conical tæniola and also pass above into the basal stomach as far as its conical point, where the cæcal ends of their cones touch in the subumbral centre of the umbrella cone. Each infundibulum represents a sub-regular cone 3 cm. high and 4 cm. in diameter at the base, and is divided by the horizontal boundary line of the pyloric opening (*gy*, figs. 12, 13), into two distinct sections of equal height, a lower distal half, and an upper proximal half. The lower or distal half of the funnel (or the "central funnel," fig. 16, 17, *ic*) lies in the outer surface of the central stomach (*gc*); its inner or axial wall is formed by the obelisk plates (*yz*) of the central stomach, its outer or abaxial wall by the subumbral wall of the coronal sinus (*cs*). The upper or proximal half of the funnel (or of the "basal funnel," fig. 14, *ib*) is encircled by the four niches of the basal stomach (*gn*), and is only joined to the inner wall of the gelatinous umbrella at the interradial line (fig. 14, *ug*). The four funnel cavities of the Peromedusæ are homologous with those of the Stauromedusæ and the Cubomedusæ, and may also be comparable to the subgenital cavities of the Discomedusæ, the respiratory cavities of older authors on the medusæ. In fact, they may serve both as means of respiration and locomotion, as they are emptied by each systole of the umbrella and filled with fresh water by each diastole; their wall is firm, but very thin.

The inner concave umbrella wall or subumbrella, shows a highly developed system of strong swimming muscles, evolved from the more simple muscles, which I distinguished in the Stauromedusæ as the distal coronal muscle and the proximal bell muscle (comp. my System der Medusæ, 1879, pp. 366, 382, 399, 456, taf. xxi. xxx., &c.). The coronal muscle ("musculus coronaris," *mc*) is improved into a powerful broad band, and more strongly developed than in all other Acraspedæ. It consists of powerful leaves of the circular muscle, whose thick supporting plate rises above the subumbral surface in the form of 10 to 12 strong circular folds; the height of these circular folds (mc_2) decreases from above to below, their breadth increases (Pl. XIX. fig. 6; Pl. XXI. fig. 8; Pl. XXII. fig. 22, *mc*). The upper or proximal margin of the coronal muscle (figs. 8, 22, mc_1) forms a simple circular line, corresponding with the distal margin of the large circular sinus. The lower or distal margin of the coronal muscle (figs. 8, 22, mc_4) forms sixteen triangular, subradially projecting points which run as far as the middle of the marginal lobes. The whole coronal muscle is therefore divided by sixteen selvages into sixteen quadrangular areæ, the coronal plates ("tabulæ coronares"). The four interradial ("ocular") are somewhat narrower than the remaining twelve ("tentacular"). They are divided by the lobe clasps ("loboporpæ," *kl*), the longitudinal fused selvages, which divides each marginal lobe into two halves (comp. pp. 66, 67); they serve at the same time as firm cartilage-like selvages for the insertion of the circular muscular fibres. Each quadrangular coronal plate corresponds, therefore, to the adjacent halves of two marginal lobes, and connects them most closely. Four of the muscular areæ correspond at the same time to the four interradial sense clubs, whilst the twelve others correspond to the tentacles. The two lateral margins of each muscular area (formed by the lobe clasps) are straight, and converge upwards; the lower or distal margin is the larger, and sinuated concavely; the upper or proximal margin is convex, and touches alternately the basis of the deltoid muscles and the distal end of the genitalia.

Whilst the large coronal muscle with its circular fibres contracts the distal part of the subumbrella, the muscle of the swimming bell ("musculus codonoides") with its longitudinal fibres answers for the proximal half of the subumbrella. The most important longitudinal muscles of this system are the eight strong deltoid muscles ("musculi deltoides," *md*; Pl. XIX. fig. 6; Pl. XX. fig. 8). They are very powerful, equilaterally triangular, and touch the proximal margin of the coronal muscle with their broad bases, whilst their truncated point is directed upwards and their longitudinal fibres consequently diverge centripetally. The four weaker perradial deltoid muscles (*md'*) are inserted by their truncated point at the distal end of the gastral openings, in the subumbral wall of the four cartilaginous palatine nodes (*gk*). The four stronger interradial deltoid muscles (*md''*), on the other hand, are longer, and inserted further up on the subumbral wall of the four septal nodes (*kn*) in the middle of the length of each pair of genitalia between the two halves. Between these, the deltoid muscle also forms, above the septal node, a thin band-shaped prolongation, which runs centripetally as far as the pylorus ("musculus intergenitalis," fig. 8, *ms*). Besides these, a stronger longitudinal muscle, which I will call "musculus congenitalis" (fig. 8, *mn*), runs into the subumbrella on the two lateral margins of each of the four gastral openings, between them and the limiting genital bands. It springs with a broader base from the inverted lateral margin of the perradial deltoid muscle, runs, gradually becoming narrower, up above between the gastral ostium and the limbs of the genitalia, and is inserted above with its narrow end in the pyloric ring (fig. 8, *gy*). Finally, a narrower and very much weaker longitudinal muscle, which may be termed "musculus axogenitalis," runs in the middle of the eight genitalia, and, in fact, on the midrib between the two limbs of each genitalium (fig. 38, *mx*). On the whole, therefore, the system of the muscle of the swimming bell ("musculus codonoides") is divided into four stronger interradial and four weaker perradial areæ; the four interradial deltoid muscles, the four intergenital muscles and the eight axogenital muscles belong to the former; the four perradial deltoid muscles, and the eight congenital muscles to the latter.

Although the circular system of the distal coronal muscle, and the longitudinal system of the proximal swimming bell muscle, form by far the most important part of the subumbral muscular system, it is represented by weaker muscles in other parts of the subumbrella. The circular fibres already mentioned, in the wall of the basal funnel cavities, belong to it on the one hand, and the longitudinal fibres on the concave axial side of the marginal lobes, which we shall briefly term "lobe muscles" ("musculi lobares," *mh*), on the other. Each of the sixteen marginal lobes has in its thin subumbral wall a pair of such longitudinal muscular bands, which run to both sides of the medial (subradial) lobe clasps (*lk*), and clearly correspond to the well-known stronger lobe muscles of the Discomedusæ.

The gastro-vascular system of *Periphylla mirabilis* (Pl. XX. figs. 8–11; Pl. XXI. figs. 12–20; Pl. XXII. fig. 22; Pl. XXIII. figs. 29–31) is distinguished from that of all

Peromedusæ by many very peculiar and complicated arrangements, which can only be completely understood after long and minute study. The only gastrovascular system among the forms of the Medusæ systems hitherto known, which offers more detailed points of comparison, is that of the Lucernaridæ, and in *Periphylla*, as in the Lucernaridæ, it is derived from that of Tesseridæ (comp. the general anatomical representation of the Stauromedusæ in my System, 1879, pp. 363–395, taf. xxi., xxii.). But whilst the essential condition of the central gastrovascular system in those Stauromedusæ resembles that of the Peromedusæ, in the Peromedusæ it differs in detail in very important and peculiar complications, and especially in the formation of the peripheric part. Generally speaking, we can distinguish in all Peromedusæ two principal sections of the gastrovascular system, the central principal intestine ("gaster principalis") and the peripheric coronal intestine ("gaster coronaris"); they are only connected by four narrow, cleft-shaped, perradial gastral openings, and are otherwise completely separate.

The central principal intestine ("gaster principalis") occupies the entire length of the axial space of the body and extends from the umbrella cone to the oral margin. It is divided by two circular constrictions or horizontal strictures into three principal sections —basal stomach (*gb*), central stomach (*gc*), and buccal stomach (*ga*). The upper or aboral circular stricture between the basal and the central stomachs, I term the pyloric opening or pylorus ("porta pylorica," *gy*); the lower or oral circular stricture, between the central and the buccal stomachs, the palatine opening or palatum ("porta palatina," *gp*). In order to gain a general correct idea of the complicated conditions of form of these three sections of the principal intestine, it is convenient to refer them to simple mathematical figures; the basal stomach is a cone (or more properly a quadrate pyramid), the central stomach an obelisk (or a truncated, regular quadrangular pyramid), the buccal stomach a cube (or a four-sided prism). The central stomach communicates with the peripheric circular sinus of the coronal intestine by four lanceolate perradial openings ("ostia gastralia").

The buccal stomach (eventually also termed proboscis or œsophagus, "gaster buccalis, tubus oralis, proboscis" Pl. XIX. fig. 6 in the centre; Pl. XX. fig. 11; Pl. XXI. fig. 19) forms the lowest oral third of the axial principal intestine, is dice-shaped on the whole, and hangs perfectly freely in the centre of the coronal hollow of the umbrella, as it is only fastened above to the subumbrella by the four perradial palatine nodes (*gk*). The length of the edge of the cube amounts to nearly 5 cm.; Plate XX. shows it apart in its natural size, fig. 9 the interradial external view, fig. 10 the perradial external view, and fig. 11 the perradial transverse section. The lower (oral) wall of the cube occupies the quadrate oral opening (*oa*), and the upper (aboral) wall the palatine opening (*gp*); the four perradial vertical lateral surfaces of the cube are formed by the buccal pouches (*bb*), the four interradial edges between them by the buccal columns (*ac*).

The oral opening ("osculum," *aa*), is shown from below in the middle of fig. 6 of

Plate XIX.; it forms a quadrangle with rounded angles. The delicate, thin membranous margin of the mouth (oral margin) is contracted inside like a narrow velum, and appears swollen and thickened at the four interradial angles by the crescentic oral ends of the buccal columns which are concave inside. Each of the latter bears two thin oral filaments two cm. long at the end of the horns of the crescent (" barbulæ, filamenta oralia," figs. 9–11, *af*). These may probably be considered as the last oral branches of the limbs of the tæniola (see below). They are thickened conically at the base, and run out to the point in a very thin long filament (or in a pencil-shaped bunch of filaments); they are amply furnished with large bean-shaped nematocysts, whose urticating threads are twisted spirally and armed with bristles.

The oral cavity (" cavitas buccalis ") is divided by the four interradial buccal columns into four perradial peripheric buccal pouches (*bb*), which only communicate with the central cavity of the mouth (*ax*) by four narrow œsophageal clefts. The four oral columns (" columnæ buccales," *ac*, figs. 9–11, 19) are nearly rectangular ridges or plates, 5 cm. high and 2–3 cm. broad, projecting inwards in the interradial meridian plane into the oral cavity. They are supported by a visible layer of gelatinous substance, several millimetres thick, which is thickest at the two lateral margins and in the middle of each plate, so that each plate is also traversed on its gastral surface by a pair of shallow, parallel, longitudinal grooves (transverse section, fig. 19, *ac*). The lateral parts of the buccal columns project like wings on the two sides of the groove (adradial oral wings, "alæ buccales," *ad*). In this respect they resemble the tæniola of the *Scyphostoma*, and, in fact, I consider them homologous with the peristome part of the latter. In *Periphylla mirabilis*, moreover, they are much less strongly developed than in the following species:—*Periphylla regina* (Pl. XXIV. fig. 3) and *Periphylla hyacinthina* (System, 1879, taf. xxiv. fig. 14). The four perradial egg-shaped buccal pouches ("bursæ buccales," *bb*, figs. 9–11, 19) project arching out externally between the buccal columns. The central spaces only of each buccal pouch opens freely into the oral cavity, their peripheric spaces have dilatations or horns which are covered for the most part by projections of the enclosing wall. Each buccal pouch is therefore divided by the projecting wings of the buccal columns into the open central space, and the lateral horns or wing pouches ("ventriculi laterales, bursæ alares," *bd*) covered by the buccal columns. Each side pouch passes above into a larger and deeper aboral corner horn, below into a smaller and shallower oral corner horn; the former ends cæcally in the upper thickened end of the wing of the buccal column (fig. 11, *ad*). The corner horns are not so depressed in this species as in the following one. The four perradial buccal clefts ("fissuræ buccales," *ae*), by which the four buccal pouches communicate with the central space of the oral cavity, are narrowed in the middle. The buccal pouches are inflated ovally out from them (figs. 9, 10, *bb*). The perradial wall of the buccal pouches is very much thinned, and is traversed by parallel longitudinal streaks, which are divided by fine transverse streaks into darker cubes (oral glands, fig. 10, *ag*). This wall becomes considerably thickened above, and then passes directly into the four perradial palatine nodes (*gk*), by which the buccal stomach is fixed to the subumbrella.

The palate or palatine opening ("palatum, porta palatina," *gp*; Pl. XX. fig. 11; Pl. XXI. figs. 12, 13, 18, *gp*) forms the important opening for communication between the buccal stomach (*ga*) and central stomach (*gc*); it can probably be completely closed by muscular contraction in the living *Periphylla*. Properly speaking, it consists of the wide central palatine opening and the four perradial palatine grooves surrounding it. The central palatine opening ("porta palatina", *gp*) is quadrate, its interradial lateral margins are formed by the upper, swollen and thickened, aboral margins of the buccal columns (*ac*), which here pass immediately into the lower delicate oral margins of the thin obelisk plates (*gz*). Its perradial corners, on the other hand, communicate by a narrow cleft (perhaps capable of closing) with the four palatine grooves which represent in some measure four secondary openings of the central principal opening (figs. 8, 11, 18, *gs*). These four perradial palatine grooves ("sulci palatini," *gs*) lead from the oral cavity immediately towards the outside into the coronal sinus, and form, at the same time the dilated distal ends of the cleft-shaped gastral openings (*go*). They are imbedded in the cartilaginous mass of the four palatine nodes ("nodi palatini," *gk*). It appears that the palatine grooves remain open even when the principal opening is completely closed, and then by contact of the two lips of their fissure can be transformed into short closed canals (of about 3 mm. in diameter).

The central stomach ("gaster centralis, obelisk stomach," *gc*; Pl. XX. fig. 8; Pl. XXI. figs. 11–18), the middle of the three divisions of the axial principal intestine, is somewhat smaller than the buccal stomach, and has, on the whole, the form of an obelisk or a truncated regularly quadrilateral pyramid (figs. 12, 13, *gc*). We can distinguish geometrically two bases and four lateral surfaces. The lower (oral) base is formed by the palatine opening described above ("palatum," *gp*), by which the central stomach opens into the buccal stomach. The upper (aboral) basis, on the other hand, occupies the quadratic pyloric opening ("pylorus" *gy*), by which the central stomach communicates with the basal stomach. The four interradial lateral surfaces of the obelisk-shaped central stomach form four trapezoid, or almost rectangular thin lamellæ, which on account of their special importance I have termed (once for all, to prevent confusion) the four obelisk plates of the central stomach ("tabulæ obelisci," *gz*). The thin wall of these quadrangular plates, which are placed more or less vertically, belongs properly to the subumbrella, and is formed by a delicate but firm gelatinous plate or supporting lamella, whose inner or axial surface is covered by gastral endoderm and its outer or abaxial surface by the subumbral ectoderm of the funnel cavities, and a thin layer of muscle belonging to it. The upper or aboral margin of each obelisk plate is formed by a quadrant of the pyloric stricture (*gy*), the lower or aboral margin by a quadrant of the palatine stricture (*gp*), whilst the two lateral or longitudinal margins are beset with a row of gastral filaments (*fc*), and form the lateral boundary margin of a gastral opening (*go*). The four gastral openings or perradial clefts of the central stomach ("ostia gastralia," *go*), are four wide, long cleft openings, by which the central stomach communicates in its whole length with the coronal sinus, and whose middle line corresponds to the four perradial borders of the obelisk, or, what is the same thing, to the ideal boundary line, at which each of the two obelisk plates touch. The gastral openings have a narrow lanceolate shape, and are broadest in the middle (6–8 mm.) and 36–40 mm. long (figs. 8, *go*; 12, *go*). The upper or aboral pointed end of each gastral opening touches the perradial point of the pyloric stricture (*gy*); on the other hand, the lower or oral end touches the perradial point of the palatine opening (*gp*), and is intersected here in the form of a peculiar groove, the palatine groove already described, which is embedded in the firm palatine nodes. The border of gastral filaments (*fg*) ends somewhat above the palatine groove.

The pylorus, or pyloric opening, is the name which I have given to the quadrate opening, by which the central stomach communicates with the basal stomach ("pylorus, porta pylorica," *gy*; figs. 8, 12, 13; *gy*, fig. 15). The four perradial angles of this quadrate form the aboral end of the four gastral ostia (*go*). The four interradial lateral lines of the quadrate, 3 cm. in length, form the upper (aboral) boundary lines of the obelisk plates, in which they touch the axial walls of the basal funnel cavities. As each of the two adjacent basal funnels touch each other by their lower ends at the pyloric opening, two gastral filaments (fig. 15, *b*) are placed in each corner of the pyloric quadrate. It is only in the four pyloric corners (fig. 15, *gy*) that the wall of the pyloric opening touches the gelatinous wall of the umbrella (*ug*), from which it is otherwise completely separated by the four interradial subumbral funnel cavities (*ii*).

The basal stomach ("gaster basalis," peduncle stomach, *gb*; Pl. XX. fig. 8; Pl. XXI. fig. 14) forms the upper or aboral third of the axial principal intestine, and has the form of a regular hollow cone, whose base is the pylorus, and whose point is the cone of the umbrella. As, however, it encloses the four interradial conical funnel cavities, it really has the geometrical fundamental form of a quadrilateral regular pyramid. This is 4 cm. high, whilst the length of its edges amounts to 5 cm. and the lateral length of its quadrate base to 3 cm. The point of the pyramid is prolonged into a narrow cæcal tube, which traverses the aboral cone of the gelatinous umbrella, and whose point nearly touches the external surface of the latter. This canal of the umbrella peduncle (fig. 8, *cb*) is here closed cæcally, and does not open by an aperture into the upper surface, as appears at first sight. The cavity of the narrow spindle-shaped peduncle canal is lined with dark-brown pigment, and therefore stands out conspicuously in the clear gelatinous mass (fig. 1, in the point above). As the four interradial conical subumbral funnel cavities (*ib*) already described traverse the whole length of the basal stomach and meet above in its point, the periphery of its conical hollow space is divided into four perradial grooves, the basal pouches, or niches of the basal stomach ("bursæ basales," *gn*). They are broadest in the middle, lanceolate above and below (figs. 8, 12, *gn*). They communicate with the simple central space of the basal stomach by four narrower longitudinal clefts, and correspond to the four peduncle chambers of *Lucernaria* (Pls. XVI., XVII., *gn*). The transverse section is therefore the same in both cases, and shows the form of a Maltese cross; but with this difference, that in *Lucernaria* (Pl. XVII. fig. 13) as in *Pericolpa* and *Peripalma* the four interradial tæniola are solid selvages, whilst in *Periphylla* (Pl. XXI. fig. 14) as in *Periphema* and *Pericrypta* they are hollow cones. Two diverging phacelli (or longitudinal rows of gastral filaments) beset the entire length of the hollow cone, and diverge from each other below at the pylorus, in such a way that the two phacelli of each two adjacent cones which are turned to each other meet in the four perradial angles of the pylorus. From thence they diverge further upon the margin of the gastral openings.

The tæniola ("tæniola gastralia," gastral longitudinal selvages, *ft*). The axial principal intestine of *Periphylla*, whose three divisions have been already described, has apparently an extremely complicated character, which separates it in a striking manner from other Medusæ. A clear, simple explanation of this may, however, be gained by comparing this axial intestine with the more simple principal intestine of the Lucernaridæ and Tesseridæ. If we abstract the secondary differentiations, and only bring forward the primary principal conditions, we are able to refer all these formations to the simple, common ancestral form, to the primary intestine of the scyphopolyps, *Scyphostoma* (comp. my System der Medusen, pp. 364, 367, 384, 403, &c.). The four endodermal interradial tæniola are already developed from this primary intestine, divide the periphery into four perradial niches or pouches, and traverse the whole length of the gastral wall, from the aboral peduncle base to the oral margin. These then characterise pre-eminently the section of the Acraspedæ, and develop the peculiar typical "gastral filaments." In their common parent form, *Tessera* as in *Scyphostoma*, we can distinguish two sections in each tæniolum, the umbral at the umbrella wall and the subumbral at the peristome wall; the two touch at the umbrella margin. From beginning to end, from the aboral central point to the oral margin, the interradial tæniola and their products show a steady tendency to centripetal growth, whilst on the contrary the perradial pouches between them show the same tendency to centripetal growth. In our *Periphylla* (1) the four funnels of the basal stomach and their rows of filaments, (2) the obelisk plates of the central stomach with rows of filaments, (3) the buccal columns of the buccal stomach with their wings and oral filaments belong to the centripetal system of the four interradial tæniola. On the other hand, (1) the four niches of the basal stomach, (2) the gastral openings of the central stomach leading into the peripheric coronal intestine, (3) the buccal pouches and wing pouches of the buccal stomach belong to the centrifugal system of the four perradial pouches. The correctness of this view is proved directly by the distribution of the eight phacelli or rows of filaments, of which each two come on one tæniolum, and are placed in some measure on two diverging limbs of the tæniola.

The phacelli or the longitudinal rows of the gastral filaments (Pl. XX. fig. 8; Pl. XXI. figs. 14–18; Pl. XXII. figs. 23–28) are extremely powerfully developed both in *Periphylla mirabilis* and in the following *Periphema regina* (Pl. XXIV. fig. 1). The number of filaments amounts to several thousand, and their length to 30 or even 40 mm. They are apparently distributed over the whole extent of the basal and central stomach that they form eight continuous longitudinal rows or "phacelli," which run divergingly from the conical basal stomach. Closer inspection, however, shows that the two phacelli of each pair originate as diverging limbs, from a simple interradial phacellus deep in the bottom of the basal stomach. They there form a simple row of short filaments, which stand freely on the interradial tæniola and project into the basal gastral cavity. This simple phacellus soon divides into two limbs, which diverge only slightly at first but more strongly afterwards. At the pylorus they diverge so strongly that they touch the meeting limbs of the adjacent tæniola in the four perradial angles of the pylorus. They then run along the margin of the gastral openings (*go*) nearly to the upper margin of the palatine groove. Each perradial gastral opening is bordered on both sides of the margin by a row of long gastral filaments, which project freely into the central gastral cavity. These filaments are generally 1–2 cm. long.; many of them, however, 3–4 cm. long; their breadth varies between ¼ and 1 mm., but often amounts to 1½–2 mm. They are sometimes more cylindrical in shape, sometimes flattened like a ribbon, often tongue-shaped at the end (Pl. XXII. fig. 23; transverse section figs. 24, 25). The structure of these gastral filaments is the same as usual (fig. 26). A gelatinous supporting plate (*z*), enclosing scattered cells, is covered with an endodermal epithelium, which contains three kinds of cells, (1) narrow, high, cylindrical flagellate cells (*fe*); (2) flask-shaped glandular cells with turbid contents, consisting partly of finely granular protoplasm, partly of large, strongly-refractive corpuscles (*fd*); (3) thread-shaped epithelial muscular cells containing nuclei (*fm*). These endodermal muscular cells, hitherto sought for in vain, exist, I believe, isolated here in the large contractile and very mobile gastral filaments (fig. 28).

The peripheric coronal intestine ("gaster coronaris") includes the entire peripheric part of the gastrovascular system (as opposed to the axial principal intestine) and occupies the whole subumbrella from the pylorus to the umbrella margin. It is divided into two principal sections, which are separated by the upper or proximal margin of the coronal muscle. The upper or proximal section itself fills the large coronal sinus, whilst the lower or distal section forms the peripheric corona of pouches. This consists of sixteen quadrangular coronal pouches, which correspond to the coronal plates of the coronal muscle. Three pouches, two lateral lobe pouches, and a middle pouch passing into a tentacle or a sense club, run out from the distal margin of each coronal pouch. The peripheric coronal intestine is only connected openly with the axial principal intestine at four points, viz., at the four perradial gastral openings (*go*).

The remarkable, enormously large circular sinus, or coronal sinus ("sinus coronaris," or "canalis coronaris,") *cs;* Pl. XX. fig. 8, *cs;* Pl. XXI. figs. 12–18, *cs*) is that part of the gastrovascular system which specially distinguishes the Peromedusæ from all other Medusæ, and which does not recur in the same form and to the same extent in any other group of Medusæ. It forms a colossal annular pouch which is placed more or less subvertically, and in *Periphylla mirabilis* is 30 mm. high, so that it fills the half of the whole height of the umbrella. In the circular sinus we distinguish an upper or proximal and a lower or distal margin, and an inner or axial and an outer or abaxial wall. The upper margin and the outer wall of the circular sinus are without any opening; on the other hand, it communicates at the lower margin by sixteen horizontal clefts, with the sixteen coronal pouches, and at the inner wall by the four vertical gastral openings with the central stomach. The lower or distal margin (fig. 15, *cs*) coincides with the proximal margin of the coronal muscle (*mc*), and has, consequently, sixteen subradial projecting corners (Pl. XIX. fig. 6). The aboral or proximal margin (fig. 15, *cs*), is a simple circular ring of the subumbrella, which coincides with the plane of the pylorus; the hollow space of the coronal sinus is here completely closed, and does not communicate with the surrounding circular pylorus; the proximal margin of the circular sinus (fig. 15, *cs*) is completely separated from the pyloric opening (*gy*) by the four interradial funnel cavities (*ii*) (which touch here), and only touches the pyloric opening externally in the four perradial pyloric corners (gy_4). The external, umbral, or abaxial wall is formed by the smooth concave inner surface of the gelatinous umbrella, and is covered by dark pigment, which is deposited in the form of black-brown balls in the endoderm cells of the umbral wall. The inner, subumbral or axial wall of the circular sinus is formed by the subumbrella, which here assumes very complicated conditions in consequence of the strong development of the four funnel cavities. Considered more closely, this axial wall is divided into an upper broader, and a lower narrower section, which is bounded by the subumbral palatine ring or the insertion of the four perradial palatine nodes (*gk*) at the subumbrella. The upper or proximal section of the axial wall, above the palatine nodes, is pierced in its entire length by the four perradial gastral openings, these important clefts already described, by which the hollow space of the central stomach opens into the coronal sinus (*go*). The lower or distal section of the axial wall, on the contrary, is perfectly simple, without openings; the deltoid muscles (*md*) lie on its subumbral surface. Moreover, the four pair of genitalia (fig. 20, *sm*) lie in the four quadrants of the axial wall of the coronal sinus, which are separated by the four gastral ostia. The colossal hollow space of the coronal sinus forms a powerful closed pouch; apart from the four septal nodes which I shall next describe, it is perfectly simple, and, moreover, so wide that I could easily introduce three of my fingers, and so realise its full extent. The powerful volume of its contents is probably subject to important modifications according to the state of contraction of its muscular and very extensible subumbral wall.

The inner or axial wall of the coronal sinus is firmly connected with its external or abaxial wall at four interradial points. These points lie exactly in the radii of the four sense clubs, in the middle third of the height of the sinus, a little above the middle (figs. 8, 12, 13, *kn*). They are the important septal nodes or fused nodes ("nodi septales, nodi cathammales," *kn;* Pl. XX. fig. 8, *kn;* Pl. XXI. fig. 17, *kn;* Pl. XXIII. fig. 33; Pl. XXV. fig. 8); they correspond to the interradial septa of the Lucernaridæ and Cubomedusæ, which divide the length of their radial pouches. Each of the septal nodes forms a gelatinous cube, tiny but firm as cartilage, of from 2–3 mm. in diameter. Under strong magnifying power, the transverse section (Pl. XXV. fig. 8) shows that the umbral gelatinous substance of the thick abaxial wall (*wg*) is firmly fused here with the gelatinous supporting plate of the subumbral axial wall (*zw*). Between the two walls, however, in the tangential median plane of each node, there is a double layer of endoderm cells, the important cathammal plate ("vascular plate or endodermal lamella," *dk*). The higher cylindrical cells of the axial cell layer (dw_2) form the direct continuation of the subumbral endodermal epithelium of the inner sinus wall (*dw*); in the same way the flatter cells of the abaxial cell layer (du_2) pass immediately into the umbral endodermal epithelium of the external sinus wall (*du*), and contain the black-brown round pigment granules by which the wall is characterised. We cannot, therefore, doubt that the nodes are really formed by fusion of the two vascular walls. The gelatinous substance on both sides of the double gastral lamella was so much hardened that it notched the knife in making sections. Under stronger magnifying power (Pl. XXV. fig. 8) it showed here the same striking induration and histological modification of the gelatinous tissue, already described in the periphery of the lobe clasps, the transition into hard fibrous cartilage (comp. above p. 67, and Pl. XXV. fig. 10).

If we suppose that the four septal nodes, prolonged centripetally to the pylorus and developed into four selvages, connect the axial and abaxial wall of the coronal sinus in its entire proximal half, the sinus would thereby be divided into four wide perradial pouches, corresponding to those of the Lucernaridæ and Charybdeidæ; and as in these the four radial pouches here communicate below by a circular canal, viz., by the simple distal half of the circular sinus, below the septal nodes. We may therefore say the ideal horizontal circular line, in which the four interradial septal nodes lie, form the boundary line between an upper and a lower coronal sinus, both of which are in open communication between the four nodes. The upper or proximal coronal sinus (cs_1) corresponds to four wide perradial pouches, whose septa are reduced to nodes, and which communicate by the gastral openings with the central stomach. The lower or distal coronal sinus (cs_2) corresponds to a very much widened coronal canal which connects the four radial pouches at the umbrella margin (as in the Lucernaridæ and Charybdeidæ). The correctness of this morphological view is also justified by comparison with the important common parent group of the Tesseridæ (System, p. 369, taf. xxi.).

The large coronal sinus is divided by the upper or proximal margin of the coronal muscle from the marginal pouch corona, which forms the principal section of the peripheric coronal intestine ("corona bursarum," Pl. XXI. figs. 12, 13, 19, 20 ; Pl. XXII. fig. 22 ; Pl. XXIII. figs. 29–32 ; Pl. XXIV. fig. 1). This corona is composed of the sixteen coronal pouches and the canals which run from them into the four sense clubs, the twelve tentacles, and the sixteen marginal lobes. The sixteen coronal pouches ("bursæ coronares," *bc*) into which the lower or distal margin of the circular sinus opens (at the proximal margin of the large coronal muscle), correspond in number, shape, and size to the sixteen coronal plates or the separate trapezoid muscular areæ of the large coronal muscle (*mc*). They are shallow quadrangular pouches, whose inner or axial wall is formed by the folded muscular area itself, its outer or abaxial wall by the smooth internal surface of the gelatinous umbrella on whose external surface there is a pedalium corresponding to each coronal pouch. The upper or proximal margin is formed by the horizontal narrow cleft, by which it communicates with the coronal sinus; it corresponds to the subumbral boundary line between the coronal muscle and deltoid muscle. The two lateral (or radial) margins are formed by the lobe clasps (*kl*), by which each coronal pouch is divided all its length from the two neighbouring pouches. As each lobe clasp cuts a marginal lobe all its length into two halves, each coronal pouch belongs to the adjacent halves of two lobes and sends out an evagination, the lobe pouch (" bursa lobaris," or lobe canal, " canalis lobaris," fig. 22, *bl*; fig. 29, *bl*) into each of these halves. As the lobe clasp (*kl*) only halves the upper or proximal part of the lobe and leaves the lower or distal part free, both pouches of each lobe are in open communication below the clasp. They consequently form a horseshoe-shaped canal, whose two parallel limbs are directed centripetally and only separated by the septum of the lobe clasp (horseshoe canal, "bursæ hipposideri," fig. 22, *bw*; fig. 29, *bu*). Its proximal openings are in two adjacent coronal pouches. If we fill one of the two lobe pouches of a coronal pouch with air, the air passes through the U-shaped canal into the adjacent coronal pouch (fig. 22, *bu*). In this way there actually arises in all Peromedusæ a connective circular canal at the umbrella margin, which in some measure resembles the festoon canal of the Narcomedusæ, runs along the margin of all the lobes, and puts all the coronal pouches into peripheric communication. In the Pericolpidæ, this wide festoon canal or marginal canal (" canalis marginalis," *cm*) is composed of eight coronal pouches and sixteen lobe pouches, whilst in the Periphyllidæ it is composed of sixteen coronal pouches and thirty-two lobe pouches (comp. my System der Medusen, taf. xxiii. xxiv.).

As the four interradial areæ of the coronal muscle corresponding to the sense clubs are considerably narrower than the twelve remaining areæ corresponding to the tentacles, the same of course holds good of the coronal pouches whose subumbral wall forms the folded muscular areæ. In the middle of the lower or distal margin of each coronal pouch, just where its two lobe pouches opens into it, a canal also runs out from it between the two lobe pouches which leads into the tentacle inserted in the coronal pouch. The four interradial sense canals ("bursæ sensillares," *bo*) which provide for the four sense clubs, are short and simple, and swell into a spheroidal vesicle ("ampulla rhopalaris," *oa;* Pl. XIX. figs. 2–3 ; Pl. XXII. fig. 22 ; Pl. XXIII. figs. 31, 32, *oa*) at the basis of each sense club (on the axial side). The formation of the twelve tentacle canals (of which four are perradial and eight adradial) is more complicated. At the tentacle basis, below the two tentacle roots, these canals can be closed by the peculiar double valvular vent-hole already described (comp. p. 68, and Pl. XXII. fig. 22, *yk′*, *cx*).

These complicated anatomical conditions of the peripheric pouch corona are more difficult to understand, inasmuch as each of the twelve tentacular coronal pouches (but not the four ocular coronal pouches) are divided into two pouches by an imperfect tangential septum (Pl. XXII. fig. 22 ; Pl. XXIII. fig. 29). These two pouches, the inner or axial velar pouch (*bc′*), and the outer or abaxial avelar pouch (*bc‴*), communicate by a longitudinal cleft in the middle of the septum which divides them ("fissura septalis," *bc‴*). This peculiar complication arises from each tentacle sending out above at its insertion (between two marginal lobes) two diverging centripetal muscles, the root muscles of the tentacles (*mk*) already described. These invaginate the lower or distal margin of the coronal pouch in such a way that each tentacle root is surrounded by a conical ectodermal hollow space, the funnel cavity of the tentacle root (*it*). The cæcal end of this funnel cavity extends to the upper or proximal margin of the coronal muscle where the point of the tentacle root is inserted. The septal fissure, by which the axial velar pouch communicates with the abaxial avelar pouch, remains between the two bifurcate diverging tentacle roots (*mk*). The "septum velare" (*wm*), which itself is hollow and separates the two pouches, has consequently a very complicated formation. It is formed by two parallel lamellæ of the velar fold, which only pass into one another above at the proximal margin of the coronal pouches and at the two margins of the septal fissure. The space between the two lamellæ, the funnel cavity of the coronal pouch ("infundibulum coronare," *ic*) is lined by the ectoderm of the subumbrella, and divided into a distal simple "funnel cavity of the tentacle base," and two diverging cæcal horns running proximally from it, the two "funnel cavities of the tentacle roots" (*it*). The muscular wall of the delicate membranes which separate these cavities forms part of the invaginated coronal muscle, and is laid in delicate folds, as is best seen from the figure of the partially-opened coronal muscle in Plate XXIV. fig. 1.

Genitalia ("sexualia," *s;* Pl. XIX. fig. 6 ; Pl. XX. fig. 8 ; Pl. XXI. figs. 17 18 ; Pl. XXII. figs. 38–40). The single specimen examined of *Periphylla mirabilis* was a mature male, whose testes had shed most of the spermatozoa. The testes ("spermaria," *sm*) form eight horseshoe-shaped or U-shaped glands, which lie adradially in the subumbral wall of the coronal sinus. The convex arch of each horseshoe is turned distally, and nearly touches the proximal margin of the coronal muscle (*mc*), whilst the two parallel limbs of the horseshoe are directed proximally (or centripetally), and their points nearly touch the pyloric stricture (*gy*). The eight U-shaped reproductive glands therefore extend in an adradial direction through nearly the entire height of the coronal sinus (*os*), and only leave a small part of the upper (proximal) margin and the lower (distal) margin of its subumbral wall free. The eight genitalia are connected in pairs, in such a way that a pair lies between each two perradial gastral openings (*go*). The two genitalia of each pair are divided by the intergenital longitudinal muscle (*ms*) in the upper (proximal) half, by the septal nodes (*kn*) in the middle, and by the interradial deltoid muscle (*md*) in the lower (distal) half. The four pairs, on the other hand, are divided by the four gastral openings (*go*) in the upper half, and by the four perradial deltoid muscles (*md*) in the lower half. The lower half only lies freely in the coronal cavity of the umbrella (*hc*), whilst the upper half is concealed deep in the funnel cavity (*ie*). The four limbs of each pair run nearly parallel in the upper half (in the funnel cavity), whilst the two genitalia of each pair diverge distally (in the coronal cavity of the umbrella), as they diverge parallel to the two limbs of the interradial deltoid muscle. The two limbs of each genitalium converge, however, at their distal end, and are connected there by the cords of the horseshoe, whose convex outer margin nearly touches the inner margin of the coronal muscle (comp. Pl. XX. fig. 8, and Pl. XXV. fig. 1). The two limbs of the horseshoe-shaped genital band are broadest below (1 cm.), and gradually narrow as they run up (0·5 cm.) towards the proximal points of the two limbs (Pl. XXIII. fig. 38). The limbs are of equal length in *Periphylla mirabilis*, whilst in *Periphylla hyacinthina* the lateral limb (next the gastral opening) is much shorter than the medial limb (next the septal nodes). (Comp. my System, Pl. XXII. figs. 13, 16.)

Structure of the spermaria (Pl. XXIII. figs. 38–48). Each of the eight horseshoe-shaped genitalia shows a projecting, nearly adradial, selvage, the genital rib ("costa genitalis, sterigma," *st*) between its two limbs. It consists of a firm selvage-like thickening of the fulcral plate of the subumbrella and of the weak axogenital longitudinal muscle (*mx*) lying on it. Gelatinous transverse selvages run, as in a pinnated leaf, from both sides of this midrib, and serve to support the separate pouch-shaped transverse folds of the genitalium (fig. 38). More minute examination shows that the testis represents a broad U-shaped arched band having many transverse folds along its whole length. The convex lateral margin of the U-shaped band is fastened to the subumbral wall of the ring sinus, whilst the concave, medial margin projects slightly into the canal space of the ring sinus. The separate pouch-shaped, arched-out, transverse folds of the genital band, amounting to about 50 to 60 in each genitalium, are of a narrow, oval or conical shape, and bear the same relation to the midrib that the pinnæ do in a pinnate leaf. Numerous secondary folds lie in each transverse fold. The interspaces between these folds perhaps develop into special genital sinuses with excretory passages opening into the pouch space and from there into the ring sinus, which probably comport themselves as in the complicated forms of the Lucernaridæ. The complicated structure of this many-folded genital band, is, however, as in the Lucernaridæ, very difficult to make out. In the single specimen of *Periphylla mirabilis* before me, the ripe pouches of the testes were already flattened for the most part, and the spermatozoa emptied into the coronal sinus. The small follicles of the testes which, closely placed together, compose the folded genital band, are placed in 3–4 layers, the one above the other, and have an irregular roundish polyhedric shape, and measure 6, 1· 0, 5· in diameter. Each single follicle (fig. 40) is surrounded and separated from the others by a thin fulcral lamella containing nuclei (*zs*). In transverse section, under stronger magnifying power, we see that the larger mother-cells of the spermatozoa (*sd*), which arise from the endodermal epithelium of the sinus wall, line the wall of the follicle, whilst the centre is filled by the ripe spermatozoa (Pl. XXIII. fig. 40 *sz*).

Periphema,[1] Hæckel, 1877.

Periphyllidæ, with four perradial buccal pouches of the œsophagus and four perradial niches of the basal stomach, united in its aboral basis. Between the niches, the four subumbral funnel cavities (or the four hollow interradial tæniola of the basal stomach) form hollow cones, which are beset with two rows of gastral filaments, but are free from them above each end, separated below the point of the cone.

I established the genus *Periphema* in 1877 (in the Prodromus Systematis Medusarum) for a large Periphyllid, of which there were, unfortunately, only broken and incomplete fragments of a single, very large specimen in the Challenger collection. I was, however, able by careful examination of these fragments, and with the help of other Periphyllidæ examined by me (viz., by comparison with the large, perfectly preserved specimen of *Periphylla mirabilis*), to compose a complete quadrant of the Medusa from the fragments, from which the figure in Plate XXIV. is drawn in its natural size. The reconstruction was more difficult, as the enormously developed proboscis or buccal stomach (fig. 3) was completely torn away from the pylorus and broken in pieces, and there were also distracting abnormal deformities—clearly in consequence of an earlier but completely healed injury—on the only remaining quadrant of the subumbrella (fig. 1), which I have of course left out in the figure. Apart from these, our *Periphylla regina* seems very closely allied to the preceding *Periphylla mirabilis*, and I therefore included it without hesitation in this genus in my System (1879, p. 421). However, I now consider it more appropriate to separate it generically from *Periphylla regina* under the name of *Periphema regina*, as I had already done in the Prodromus (1877). Whilst in the true *Periphylla* (*P. mirabilis*, *P. hyacinthina*, &c.) the four large interradial conical funnel cavities of the subumbrella traverse the whole length of the central and basal stomach, and meet with their points in the centre of the umbrella cone, in *Periphema regina* they stop short a little way below the subumbrella, so that the four points of the conical funnel cavities remain separated by a basal hollow space, which has the geometrical basis of a quadrate pyramid, and fills the point of the cone. The four perradial niches of the basal stomach are consequently connected at their aboral ends by this conical cavity, whilst they are completely separated in the true *Periphylla*.

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[1] Περιφημος = greatly renowned.

Periphema regina, Hæckel (Pls. XXIV., XXV.).

Periphema regina, Hæckel, 1877, Prodrom. System. Medus., No. 389.
Periphylla regina, Hæckel, 1879, System der Medusen, p. 421, No. 423.

Umbrella bell-shaped, nearly as high as broad. Pedal zone of the exumbrella rather narrower than the lobe zone, both together nearly as high as the cone zone. Marginal lobes, oval, rounded obtusely, their distal wings nearly semicircular, about half as high as their proximal gelatinous swelling. The eight tentacle lobes project further on the umbrella margin than the eight rhopalia lobes. Tentacles very thick, nearly as long as the height of the umbrella, one-third as broad at their base as the marginal lobes. Œsophagus cubical, very large and very thick-walled, nearly half as high and half as broad as the umbrella, the oral margin in the plane of the umbrella margin, without barbous filaments. Horizontal diameter, 180–200 mm.; vertical diameter, 180–200 mm.

Habitat.—The Antarctic Ocean, south-west of the Kerguelen Islands. Lat. 62° 26′ S., long. 95° 44′ E. Station 156. The large specimen, to which the fragments examined belonged, was a mature female, and was taken from a depth of 1975 fathoms, 26th February 1874. The colour of the broken fragments, otherwise well preserved in spirit, was reddish, the ovaries were brownish-yellow and the endodermal epithelium of the abaxial wall of the coronal sinus—or the inner surface of gelatinous umbrella—from dark red-brown to black-brown.

The umbrella (Pl. XXIV. figs. 1, 2) of *Periphema regina*, as far as could be made out from the fragments to hand, is bell-shaped, considerably more depressed than in *Periphylla mirabilis*. Its apex is flatly truncated, and nearly equal in height to the diameter of the bell opening, 18–20 cm. The exumbrella is divided by a broad, deep coronal furrow (fig. 2, *ec*), nearly in the middle of the height, into an upper umbrella cone, and a lower umbrella corona. The umbrella cone is smooth, flattened above, and almost hemispheroidal. The coronal furrow is very broad, and the gelatinous substance of it very much thinned. It is divided by sixteen subradial longitudinal furrows (which pass below into the lobe clasps) into sixteen broad, crescentic areæ ("areolæ semilunares," fig. 2, *ec*). A vane-like-shaped process of the exumbral zonal muscle (*mz*) lies between the crescentic folds at the end of each longitudinal furrow. The umbrella corona may be subdivided into an upper pedal girdle and a lower lobe girdle. The pedal girdle ("zona pedalis") is, however, much less strongly developed than in most other Periphyllidæ, and hardly 2 cm. high. The pedalia are slightly vaulted and comparatively small. The lobe girdle of the umbrella corona (figs. 1, 2, "zona lobaris") is more strongly developed in *Periphylla regina* and differently shaped from that of *Periphylla mirabilis.* The sixteen subradial marginal lobes are much larger compared to the pedalia, and are rounded, not pointed. The difference in size between the four pair of ocular lobes, and the four pair of tentacle lobes alternating with them is considerably greater. Neither the two gelatinous swellings lying in each marginal lobe nor the inter-furrow are so thick as in *Periphylla mirabilis;* the lobe clasp ("loboporpa," fig. 2, *kl*), which lies at the bottom of this furrow, and supports the septum between the two halves of the pouch, is much feebler, but shows the same structure in transverse section, fig. 10, comp. above, p. 71), on the other hand, the thin delicate wings ("patagia," *lp*), which form the selvage of the lobe margin, are much broader and longer in our species than in the foregoing. If we measure from the circular line of the exumbrella, indicated by the insertion of the tentacles between the marginal lobes, the tentacle lobes are 50 mm. long (without wings, 35 mm.), and the ocular lobes only 45 mm. (without wings, 30 mm). The tentacle lobes are more than 30 mm. broad in the middle, the ocular lobes a little over 20 mm. (figs. 1, 2).

The four interradial sense clubs in this species appear to be very small and almost rudimentary (fig. 2, *o*); in the fragment to hand, however, there was only one preserved, and it did not allow of closer investigation. Only half of the twelve tentacles were preserved (figs. 1, 4). They are on the whole of the same nature as in the preceding species (comp. above, p. 67), but are considerably shorter and thicker. Their length is nearly equal to the height of the umbrella (18–20 cm.), whilst in *Periphylla mirabilis* it is twice as great. The longitudinal muscle appears to be less strongly developed. The thickness of the hollow tentacles at the conically swollen base amounts to 10 mm. They then thin away into a cone and run out below into a fine point (fig. 2, *t*). The peculiar insertion of the tentacle by two root muscles (*mk*) inside a tentacle funnel (*it*), and the remarkable formation of the double-valved vent-hole at its base, is the same here as has been already described in *Periphylla mirabilis* (comp. Pl. XXII. fig. 22, and Pl. XXV. fig. 1).

The inner concave umbrella wall (subumbrella, Pl. XXIV. fig. 1) in *Periphema regina* shows on the whole the same conditions already (p. 71) described in detail in *Periphylla mirabilis.* The muscular system is, however, much more strongly developed in the former, and the separate muscles show more prominently. The eight longitudinal deltoid muscles ("musculi deltoidei") are yellowish-white, very stout, firm glistening bands, and appear remarkably powerful. The strongest is the interradial deltoid muscle (fig. 1, *md'*), an equilateral triangle, 36 mm. in height, 32 mm. at base, whose truncated point reaches as far as the middle of the genitalia, and is there inserted at the interradial septal node (*kn*). The muscular fibres which diverge radially from its point towards the base are nearly equally powerful throughout. The narrow "musculus intergenitalis" (*ms*) above, between the two genitalia of each pair, is formed by a weaker process of this deltoid muscle. The perradial deltoid muscle (*md'*) is weaker than the interradial; it forms an equilateral triangle 20 mm. in height, 25 mm. at base, whose truncated point reaches as far as the oral end of the gastral opening (*go*), and is inserted there below the palatine groove (*gs*) at the perradial palatine node (*gk*). The lateral muscular fibres (*md'''*) are much more strongly developed in this muscle than in the median muscles. A band-shaped "musculus congenitalis" (*mp*) springs from each side of the perradial deltoid muscle; it lies coradially between the outer margin of each genitalium (*s*) and the gastral opening (*go*), and extends to the upper end of the latter. This band-shaped congenital muscle is 10 mm. broad below, 5 mm. broad above; its length amounts to 60 mm. Its fibres which run parallel, and only converge slightly above, spring from the lateral margin of the perradial deltoid muscles, and are inserted above at the pyloric opening (*gy*).

The broad coronal muscle (fig. 1, *mc*) shows essentially the same condition as that already described in *Periphylla mirabilis* (p. 71). Its proximal margin (*mc*) serves as a basis of origin for the deltoid muscles. Its subumbral surface is elevated into 10 to 12 circular folds (mc_2) with deep furrows sunk between them (mc_3). The coronal muscle is also divided by the sixteen subradial lobe clasps into sixteen coronal areæ. These are 25 mm. high in the middle (between each two marginal lobes), but 30 mm. high laterally in the middle of each marginal lobe. The four ocular muscular areæ (25 mm. broad) are only a little smaller than the twelve tentacular coronal areæ (30 mm. broad). The intermediate lobe clasps are much weaker than in the preceding species, but show the same structure in transverse section (fibrous cartilage, Pl. XXV. figs. 9, 10). The formation of the lower or distal margin of the coronal muscle (Pl. XXIV. fig. 1, mc_4) is peculiarly differentiated. Whilst in *Periphylla mirabilis* it is quite smooth, projects internally like an umbrella roof over the insertion of the tentacles, and forms a simple tentacle funnel (*it*), in *Periphema regina* it is fringed and divided into numerous fine folded lobes or "frenula." On each of the sixteen muscular areæ there are nearly twenty such frenula, 2–3 mm. long, which connect the distal margin of the muscle with the subumbral surface of the marginal lobe lying below it. An equal number of subumbral funnel-shaped depressions are deeply inserted between these frenula in the thickened distal margin (" infundibula subcoronaria").

Both parts of the umbrella cavity, the lower simple coronal umbrella cavity and the upper quadrilocular funnel umbrella cavity, comport themselves the same on the whole in *Periphema regina* as in *Periphylla mirabilis.* The simple coronal umbrella cavity forms a circular hollow space, whose subumbral external wall forms the umbrella corona with the coronal muscle and the deltoid muscle lying above it. The wide hollow space of the coronal umbrella cavity is filled, for the most part, by the powerful buccal stomach, whose oral margin extends to its opening. The quadrilocular funnel umbrella cavity (which is sharply defined by the four palatine nodes (*gk*) from the simple umbrella coronal cavity) shows however an essential variation in our species. Whilst in *Periphylla mirabilis* the four conical interradial umbrella funnels traverse the whole length of the central and the basal stomach, and meet above in the central point of the umbrella cone, in *Periphema regina* they stop some little way below the cone; the four points of the funnels are here inserted separately at four interradial points of the umbral wall of the flattened basal stomach, which are at 4 cm. distance from each other. This occasions a perfectly different formation of the basal stomach, which chiefly justifies the foundation of the genus *Periphema.*

Apart from the differentiated formation of the basal stomach, the gastrovascular system of *Periphema regina* shows essentially the conditions already described in detail in *Periphylla mirabilis.* Only the special formation of single parts and their comparative sizes show unimportant differentiations. Of the three chief sections of the axial principal intestine, the buccal stomach is the largest, being 8 mm. high, whilst the height of the central stomach and of the basal stomach only amounts to 5 cm.

The buccal stomach or œsophagus (fig. 3) is extremely fleshy and thick walled. The four quadrants of the œsophagus were found as four isolated fragments, still partially connected with the pieces broken off from the central stomach, in the bottle containing the incomplete remains of our species. One such quadrant is represented in natural size in fig. 3. Each quadrant contains a complete buccal pouch (*bb*), and the enclosing half of the oral column touching it (*ee*). From the beast having been torn during its capture, the œsophagus was quartered through the interradial meridian planes. The reconstructed form of the buccal stomach is on the whole that of a cube of 7 cm. to the side; more closely considered, it forms rather an octagonal prism with alternating broad and narrow lateral surfaces; the former are formed by the buccal pouches, the latter by the oral columns. The oral columns ("columnæ buccales," fig. 3, *ac*), are remarkably strong, and supported by a powerful, fleshy, gelatinous swelling. The adradial wings of the oral columns ("alæ buccales," *ad*) appear extremely fleshy, and laid internally in strong longitudinal folds, whilst their interradial middle plate is thinner, very much extended and diminished in size, towards the oral margin. The wings project internally considerably above the lateral parts of the buccal pouches, so that they are arched out on both sides into spacious wing pouches. The buccal pouches ("bursæ buccales," *bb*), when inflated would be almost hemispheroidal: their wall is supported by a thin, elastic but firm, gelatinous plate, which is broadened below and rounded obtusely at the oral margin. The distal ends of the eight adradial wings therefore project most below at the oral margin (*am*), without running out into barbous filaments as in the preceding species. The unusual strength of this large proboscis indicates a predatory mode of life.

The central stomach appears capable of being completely shut off from the buccal stomach, as the palatine opening (*gp*) is narrowed by strongly-projecting palatine swellings, and both the four perradial palatine nodes (*gk*) and the contiguous lateral parts of the palatine grooves are also considerably thickened. On the other hand, the four obelisk plates of the central stomach are very delicate and thin walled (torn for the most part). The four perradial angles of the quadrate pyloric opening coincide with the four proximal ends of the four cleft-shaped gastral openings.

The basal stomach (*gb*) shows an essentially different formation from that of the preceding species. In the latter the four perradial peripheric niches surrounding its conical axial space are completely separate from each other, whilst the four interradial funnel cavities of the subumbrella run above as far as the point of the conical basal stomach and meet there in the centre of the umbrella cone. In *Periphema regina*, on the other hand, the interradial funnel cavities end 2 cm. below the basal centre point of the basal stomach. The latter consequently forms a quadratic undivided depression in the bottom of the flatter vaulting of the cone with the funnel cavities and their phacelli springing from its four angles. The distance of these four points (the lateral length of the quadrant) amounts to 4 cm. The shattered condition of the fragments before me, did not allow of the complete reconstruction of the basal stomach. The central part of the umbrella cone with its four funnel points was, however, preserved, and showed clearly that the four perradial niches of the basal stomach communicate freely. This peculiarity distinguishes *Periphema* generically from *Periphylla*.

The phacelli or longitudinal rows of gastral filaments in *Periphema regina* are extremely large and more strongly developed than in any other Medusa known to me. They consist of several thousand strong and very long filaments, placed in several rows along the gastral tæniola (not in a single row as in the preceding species). The filaments are longest in the middle of the phacelli, up to 80 mm. long and 1 mm. thick. They become shorter and thinner towards both ends, and are then mostly only 10–20 mm. long and hardly 0·5–0·2 mm. thick. Their special formation and distribution is the same as in the previous species. Two diverging phacelli run from the cone point of each of the four interradial funnels, extending on the lateral margins of the gastral openings as far as the pylorus, and ending 1 cm. above the palatine groove (fig. 1). The filaments are sometimes cylindrical, sometimes flattened like a ribbon, often thickened into knots and tongue-shaped at the end. The nature and disposition of these glands is the same as in the preceding species. The lumen both of the central and the basal stomach is occupied for the most part by this mass of filaments.

The peripheric coronal intestine in *Periphema regina* shows the same formation as that already described in detail in *Periphylla mirabilis* (p. 78). The colossal coronal sinus (*cs*) which only communicates with the central stomach by the four perradial gastral openings, is divided a little above the middle into four quadrants by the four interradial septal nodes (fig. 1, *kn*). These "cathammal nodes" are only a few millimeters large, but consist of very firm fibrous cartilage (comp. above, pp. 67, 80; and Pl. XXV. fig. 8). The peripheric pouch corona, into which the coronal sinus opens at its lower margin by sixteen tranverse clefts (at the upper margin of the coronal muscle), is divided by the sixteen subradial lobe clasps into sixteen coronal pouches; and each of these is subdivided by the invagination of the tentacle funnel into an inner and an outer coronal pouch (axial velar pouch and abaxial avelar pouch). Besides these, each coronal pouch gives out two lobe pouches below, which compose the marginal "festoon canal"; and whilst each of the four interradial coronal pouches sends an ocular pouch to the sense club, each of the twelve remaining coronal pouches sends out a wide tentacle canal into each tentacle (comp. above, p. 81, and the explanation of Pl. XXV. fig. 1).

Genitalia (Pl. XXIV. fig. 1, *sf*). The fragment before me belonged to a mature female, but only one pair of the four pairs of reproductive glands was preserved. The two ovaries of this pair showed the situation and form represented in the middle of fig. 1. They lay between the gastral openings in the subumbral wall of the coronal sinus, whose upper and lower margin they almost touch with both ends. Both ovaries of the pair lie almost parallel beside each other in the upper half, and are only separated by the narrow intergenital muscle (5 mm. broad). On the other hand they diverge strongly in the lower half, as there the triangular interradial deltoid muscle (*md'*) is inserted between them. The distance between the lower ends amounts to 50 mm. Each of the eight ovaries forms a narrow horseshoe-shaped arched genital band, whose convex distal arch nearly touches the upper margin of the coronal muscle (*mc'*) below, whilst the two parallel limbs, which lie close together, almost reach above to the pylorus (*gy*). The thickened supporting plate of the subumbrella forms a projecting midrib ("sterigma, costa genitalis," *st*) in the middle between the two limbs. The genital band is raised on both sides into a series of folds, which project internally into the umbrella cavity and externally into the coronal sinus (figs. 5, 6). The number of these broad folds, which are subdivided like a fan into smaller folds (figs. 5, 6), amounts from 40 to 50 in each ovary (20 to 25 in each limb). They are 4–6 mm. long, 2–4 mm. broad, and closely packed with spheroidal ova. The smallest ova lie at the basal margin of insertion of the folds, the largest at the freely projecting margin, which is turned towards the "costa genitalis" (*st*). At the basis of the folds we see clearly that the smallest and youngest ova originate immediately from the endoderm cells which line the subumbral wall of the coronal sinus. As soon as the ova grow to a certain size, each ovum becomes enclosed in a gelatinous fulcral sheath (fig. 7, *yz*), a superficial abaxial growth of the supporting plate of the subumbrella (*uz*). In transverse sections, through the genital folds, we see the ova, enclosed in these fulcral capsules, lying in rows beside one another (fig. 7). The extension and strength of the fulcral capsule increases proportionately with that of the ovum enclosed. The ripest ovum of *Periphema regina* reaches the extraordinary size of a millimeter and more. The ova consist for the most part of an opaque food yolk, composed of spheroidal yolk granules of equal size (0·01 mm. diameter), thickly compacted (fig. 4, *yd*). Each ripe ovum is also enclosed (inside the fulcral sheath) by a thick structureless (?) chorion (fig. 4, *yc*), showing a projecting micropyle at one spot (fig. 4, *ym*). It has the form of a short bottle neck, and resembles the micropyle known in the eggs of our freshwater mussels (*Naïadacea*). Below the micropyle we can distinguish with the naked eye a white spot (" cicatricula ") on the yellow yolk, in which the large spheroidal germinal vesicle is enclosed ("nucleus," *yn*). It contains a visibly dark, germinal spot ("nucleolus," *yf*), and this again contains a large double contoured germinal point (" nucleolinus," fig. 4, *yp*).

Order VIII. CUBOMEDUSÆ, Hæckel, 1877.

Acraspedæ with four perradial sense clubs, containing an auditory club with endodermal otolite sac and one or more eyes; four interradial tentacles or bunches of tentacles. Stomach with four wide perradial quadrangular pouches separated by four long, narrow interradial septa or fused selvages. Genitalia four pair of leaf-shaped swellings, which are fastened by one margin along the four interradial septa, are developed from the subumbral endoderm of the gastral pouches, and project freely into their hollow space.

Family CHARYBDEIDÆ, Gegenbaur, 1856.

CHARYBDEIDÆ, Hæckel, System der Medusen, 1879, p. 433, taf. xxv.

Cubomedusæ with four simple, interradial tentacles and four perradial sense clubs; without marginal lobes in the velarium, but with eight adradial marginal pouches; without pouch arms in the four broad perradial pouches.

Sub-family, TAMOYIDÆ, Hæckel, 1877.

Charybdeidæ with velar canals, and with four perradial frenula of the velarium.

Charybdea,[1] Péron and Lesueur, 1809.

Charybdeidæ with four simple interradial tentacles, having pedalia; with suspended velarium (with velar canal and four perradial frenula). Stomach flat and low, without broad mesenteries; central stomach and basal stomach fused, without distinct pyloric stricture. Four horizontal groups of filaments, simple or double, bush-shaped or brush-shaped, limited to the interradial corners of the bottom of the stomach.

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[1] Χάρυβδις=an eddy, a gulf, rapacious.

The genus *Charybdea*, the oldest known genus of this family and order, was founded by Péron in 1809, with the following indefinite diagnosis:—"La concavité de l'estomac se confondant avec celle de l'ombrelle; rebord garni de faux bras, ou plutôt de faux tentacles" (Tableau des Meduses, &c., Annal. Mus. H. N., vol. xxiv. p. 332). Péron united in this genus two entirely different Acraspeda, both of which he knew only very superficially and incompletely—the Mediterranean *Charybdea marsupialis* and the æquatorial Atlantic *Charybdea periphylla*. The latter was first seperated by Steenstrup and raised to be the representative of the genus *Periphylla*. On the other hand, the genus *Charybdea* was retained by almost all new authors for the known *Charybdea marsupalis* of the Mediterranean, which had already been described and figured by Plancus in 1739, as "urtica soluta marsupium referens," and of which Milne-Edwards had given a very full (though for the most part mistaken) description in 1833. Quite recently (1879) Claus gave a very detailed histological monograph of this type of the genus *Charybdea*. I was myself able to examine several new species of this genus, and to re-describe its character more minutely. In the sense which I have retained here, those Charybdeidæ which have a suspended velarium (with canals and frenula) belong to the *Charybdea*. *Charybdea* is distinguished from the genus most nearly related (*Tamoya*) by the flat, low pouch-shaped stomach, the narrow mesenteric folds, and, specially, by the formation of the gastral filaments. These are distributed horizontally in the four perradial corners of the bottom of the stomach, as four simple or double pencil-shaped or brush-shaped groups of filaments, whilst in *Tamoya* they extend as four vertical bands in the interradial lateral lines of the large depending gastral sac. The deep-sea species described below is, on the whole, nearly related to the Mediterranean *Charybdea marsupialis*, which is only half the size, but is distinguished from it by the broader velum, containing twice as many velar canals, which are also much more richly dendritic. Moreover, the sculpture of the exumbrella is different. The histological conditions have been described in great detail by Claus in his monograph on *Charybdea marsupialis*; we shall therefore confine ourselves to a short account of the organological peculiarities, giving special prominence to the specific differences shown between *Charybdea murrayana* and *Charybdea marsupialis*. There may perhaps be sufficient to justify this species being taken as the representative of a separate genus: *Charybdusa*. I have named this species in honour of my friend John Murray, first assistant in the Challenger Commission.

Charybdea murrayana, Hæckel (Pl. XXVI.).

Charybdea murrayana, Hæckel, 1879, System der Medusen, p. 442, No. 436.
Charybdusa murrayana, Hæckel, 1877, Prodrom. System Medus., No. 408.

Umbrella bell-shaped, almost cubical, rather higher than broad, depressed above, somewhat widened below; lateral surfaces almost quadratic. Stomach quite flat with four short oral lobes, four tuft-shaped phacelli, composed of bunches of large brush-shaped filaments. The vertical distance of the heart-shaphed sense niches from the umbrella margin half as great as the horizontal distance of the pedal bases. Velarium, broad with twelve dendritic velar canals in each quadrant. Pedalia, a longish oval, one-third as long as the height of the umbrella. Tentacles cylindrical, longer than the height of the umbrella. Horizontal diameter of the umbrella, 50 mm.; vertical diameter, 60 mm.

Habitat.—West Coast of Africa, not far from Sierra Leone. Lat. 30° 10′ N., long. 14° 51′ W. Depth, 200 fathoms. Station 348. There were two well-preserved female specimens, taken 9th April 1876.

The umbrella (Pl. XXVI. figs. 1, 6) is, on the whole, nearly cubical, as in most Cubomedusæ. The vertical diameter (60 mm.) is however rather greater than the largest horizontal diameter (50 mm.); four rounded, interradial "corner pillars" (corresponding to the tentacles) project more or less strongly at the four vertical lateral corners of the cube, whilst the four perradial lateral walls (corresponding to the pouches) recede between the pillars and seem more depressed. As they do not lie quite vertically but diverge a little below, the umbrella has really the shape of a truncated, regular quadrilateral pyramid. Its upper apical surface is slightly depressed and circumscribed like a cap, by a horizontal coronal furrow.

The exumbrella, as in most Cubomedusæ, is divided by longitudinal furrows into a number of areæ, projecting convexly between the furrows. We can generally distinguish sixteen such exumbral furrows, viz., firstly, eight subradial furrows (fig. 1, *ea*), which separate the four broader perradial lateral walls from the four narrower corner pillars; secondly, four perradial furrows, which divide the four depressed lateral walls in two and extend downwards from the ocular crypt to the velarium (fig. 1, *ep*); and thirdly, four interradial furrows, which halve the four projecting corner pillars (*ei*). The last-named furrows are the deepest, so that the two halves of each pillar project in the form of semi-cylindrical swellings. The four pedalia, which bear the tentacles, run out below from the pillars. The four perradial sense clubs, alternate regularly with the pedalia, and lie high above the umbrella margin in a special cavity of the exumbrella, the sense niche ("crypta rhopalaris," *eo*). The external heart-shaped entrance to this deeply hollowed crypt is partly covered by the scale of the rhopalium ("squama rhopalaris"), a protective scale of the exumbrella, projecting above the opening like a roof. The exumbrella appears finely granulated, as numerous urticating warts or round groups of thread cells are scattered freely over it. The gelatinous substance of the umbrella shows a considerable degree of firmness, in spite of its being very thin and without any cellular elements. The gelatinous substance varies in thickness in different places, according to the different longitudinal furrows of the exumbrella and the subumbrella, being thinnest along the interradial furrows (in the middle of the corner pillars) and thickest at the two sides of the pillars, and above in the cap-shaped apical cover of the umbrella (figs. 1–3, *ug*).

The subumbrella or nectocalyx is nearly cubical. The four corners of the cube are interradial and formed by the narrow septa of the broad gastral pouches, or by the "fused streaks" by which the subumbrella is connected with the umbrella. The muscular layer of the subumbrella is thus divided into four rectangular muscular plates, which are placed nearly vertically to each other in the interradial "fused streaks"; they correspond to the four lateral surfaces of the cube, and form the axial wall of the four radial pouches (fig. 3, *mw*). The circular fibres of each muscular plate are, however, interrupted in its perradial middle line by a band-shaped, longitudinal muscle, which extends from the ocular niche, upwards to the mesogonia and downwards to the frenulum (fig. 3, *mp*). The broad coronal muscle is therefore actually divided here into eight quadrangular coronal areæ as in *Pericolpa* (System, taf. xxiii.). Whilst, however in *Pericolpa*, these areæ lie in the principal radii (four perradial and four interradial), in *Charybdea* they are placed adradially.

The umbrella margin (figs. 1, 5, 8), in a wider sense, bears four perradial sense clubs and four interradial tentacles. These marginal organs are connected by a remarkable nerve ring of peculiar structure. Below this nerve ring, however, the umbrella margin passes into a broad velarium, a thin marginal membrane resembling the velum of the Craspedotæ, but, however, essentially different. As regards the eight marginal organs they are undeniably derived phylogenetically from the eight principal tentacles of *Tessera* and *Tesserantha* (Pl. XV.); the four sense-clubs from the four perradial principal tentacles, and the four tentacles from the four interradial. In this respect the condition is exactly inverted in the Cubomedusæ, as in the Peromedusæ (specially in the Pericolpidæ). In the Discomedusæ all the eight principal tentacles are transformed into rhopalia.

The velarium or marginal membrane (figs. 2, 5, 8, *va*), represents a membranous, annular distal process of the umbrella margin. It has hitherto been simply termed velum, and placed beside the similarly termed velum of the Craspedotæ. These two formations are, however, only analogous, not homologous; they have originated independently of each other, and their structure though similar is in no way identical, that is, their relation to the nerve ring is essentially different. As in all *Charybdea* belonging to the sub-family of the Tamoyidæ, the velarium is traversed by special canals, and is fastened in a very peculiar fashion to the subumbrella by the four perradial frenula (suspensors or supporting folds, figs. 2, 8, *vf*). These frenula are muscular, vertical, gelatinous folds, formed by a visible, perradial thickening of the gelatinous supporting plate, and stretching from the sense depression to the free margin of the velum. They keep the velarium suspended horizontally, and can raise it still higher by contraction of their longitudinal muscles. The velarium is divided by the four perradial frenula on the one hand and the four interradial pedalia on the other, into eight adradial octants or "velar lobes." These are homologous in position and morphological importance, with the eight free marginal lobes of the *Pericolpa*, and the eight arms of the Lucernaridæ (comp. *Lucernaria*, Pls. XVII., XVII., and also my System, taf. xxii., xxiii.). Hence we see that the velarium of the Cubomedusæ corresponds to a corona of eight fused adradial marginal lobes.

The umbrella cavity (figs. 2–6) is almost cubical, corresponding to the subumbrella. Its four vertical sides are formed by the subumbral walls of the four radial pouches, the upper surface by the subumbral gastral walls; the lower surface is occupied by the umbrella-opening, which is strongly contracted by the projecting velarium. The stomach hangs down in the axial space of the umbrella cavity; its peripheric space is divided above into four small interradial funnel cavities ("infundibula"). These are formed in the upper (proximal) part of the umbrella cavity in such a way that they stretch across the four perradial mesogonia (which we shall describe below) from the four corners of the stomach to the middle of the four radial pouches. The frenula of the velarium correspond to these proximal suspensors in the lower distal part; four corresponding niches are sunk as velar funnels between the frenula. The horizontal diameter of the umbrella disk is consequently smallest in the four centripetal projecting perradial lines, largest in the centrifugal projecting interradial lines (along the cathammal septa); the former correspond to the lateral lines of the quadrate, the latter to the diagonal lines.

The pedalia, or gelatinous sockels (figs. 1–5, *wi*), are four peculiarly-shaped interradial gelatinous appendages of the umbrella margin. They bear the tentacles at the distal end, and are sharply defined from them. Gegenbaur terms the sockels of the *Charybdea* "marginal leaves," Fritz Müller "processes of the corner swellings," and Claus "umbrella lobes." Claus compares them erroneously with the marginal lobes of the other Acraspeda. But these true marginal lobes never lie in the principal radia of the first and second order (perradial and interradial), but always between them. On the other hand, the peculiar pedalia of the Cubomedusæ always lie interradially, and can only be compared to the pedalia in the Peromedusæ, which bear both tentacles and sense clubs (comp. above, p. 65). In our *Charybdea murrayana* (figs. 1–5, *wi*) the pedalia are cuneiform or trilaterally prismatic in the upper third, compressed laterally in the two lower thirds, and shaped like a thin longish oval leaf, nearly a third as long as the height of the umbrella; its axial edge is curved concavely, its abaxial edge convexly, whilst its lateral surfaces appear bent unsymmetrically. The tentacle springs from its truncated distal end; the thicker proximal end is cut out concavely, and inserted at the lower part of the corner, swelling above the umbrella margin in such a manner that a small axial cavity, or pedal funnel ("infundibulum pedale," fig. 3, *it*), remains between the two.

The four tentacles are strong, cylindrical, hollow filaments, 4 mm. thick, thickened, like a club at the basis (to 6 mm.), and longer than the height of the umbrella (probably several times as long in the uninjured animal). In the longitudinal and transverse sections, their thick wall shows the same peculiar and complicated structure, fully described by Claus in *Charybdea marsupialis.*

The four perradial sense clubs or marginal bodies ("rhopalia") lie above the umbrella margin, in the ectodermal sense niches ("crypta rhopalaria or ocularia") already mentioned. The structure of these highly-developed organs of sense in *Charybdea murrayana* is the same as in the Mediterranean *Charybdea marsupialis*, where they were first investigated by Gegenbaur in 1836, and recently and minutely by Claus in 1878. They have a very complex structure, and essentially resemble those of the Peromedusæ and Discomedusæ, as they contain both optical and acoustic organs; their finer structure, however, varies in several respects, and in some ways very peculiar. Each sense club is fastened by a thin peduncle into the sense niche of the exumbrella, and is partly covered externally by the protective scale, which projects like a roof over the exodermal aperture of the rhopalar niche. It contains a large otolite sac containing numerous crystalline endodermal otolites in its club-shaped swollen terminal part. The six eyes, two larger unpaired in the perradial middle line, and four smaller paired on the two sides of the unpaired, lie above the otolite sac; each unpaired eye consists of a pigment cup, a thick lens, and a powerful corpus vitreum lying between them; the lens is wanting in the smaller paired eyes. A very large ganglion opticum of a highly developed structure forms the nerve centre of the optical apparatus.

The nervous system has the same high centralisation as in the other Cubomedusæ, and corresponding to their highly developed organs of sense, it shows itself in a more complete and more centralised form, than in the other Acraspeda; in this respect it attains the highest stage of formation among all Acraspeda. The central nervous system, which was discovered in *Tamoya* by Fritz Müller (1859), consists of a complete nerve ring and of eight ganglia, the four larger perradial being placed at the basis of the sense clubs, and the four interradial at the basis of the tentacle pedalia; from the perradial ganglia sense nerves go out to the organs of sense and motor nerves to the longitudinal muscles, while motor nerves go out to the tentacles from the interradial ganglia. The former always lie considerably higher than the latter, so that the nerve ring rises in a vaulted arch from the rhopalar niche to the basis of the pedalia. The whole nerve ring (figs. 2–8, *rc*) therefore forms four depressed arches. Their highest part lies perradially, their lowest part interradially. The nerve ring lies embedded in a groove of the subumbrella, interrupting its muscular plate, and consists of a clear axial cord and two more turbid fibrillar cords (an upper and an under) lying on it with the peculiar nerve epithelium lying above them. Extensive plexuses of fibrillæ with large multipolar and spindle-shaped ganglion cells run out thence and spread chiefly on the subumbrella. The finer structure of the nervous system and the organs of sense have been recently described in detail by Claus in *Charybdea marsupialis* (1879, *loc. cit.*). His endeavour to compare the condition of this structure of the Cubomedusæ with that of the Craspedota, is, however, untenable, as the two have arisen independently of one another, and are, therefore, not homologous. The nerve ring of the Cubomedusæ also corresponds only to the lower (subumbral) nerve ring of the Craspedotæ, whilst the upper (exumbral) ring of the former is entirely wanting. On the other hand, the central nervous system of the Peromedusæ is probably essentially closely allied to that of the Cubomedusæ.

The gastrovascular system (figs. 1–10) resembles that of the Stauromedusæ in the simplicity of its formation (*Tesserantha*, Pl. XV.; *Lucernaria*, Pls. XVI., XVII.). The principal stomach or axial intestine is connected by four horizontal perradial gastral openings with four wide quadrangular radial pouches, which are divided in their entire length by four narrow interradial septal selvages, and communicate by a narrow circular canal at the distal end of the selvages. The axial principal intestine, or the stomach in the wider sense ("gaster principalis"), really consists in most Cubomedusæ of the same three sections as in the Stauromedusæ and Peromedusæ, viz., an aboral basal stomach, a middle central stomach, and an oral buccal stomach; the pyloric opening ("pylorus," *gy*) also forms in this case the boundary between the basal and the central stomach and the palatine opening ("palatum," *gp*), that between the central and the buccal stomach. In *Charybdea*, however, as in many other Charybdeidæ, the pyloric opening is very wide and the pyloric stricture very slightly developed, so that, taken together, the basal and the central stomach seem to form a single, simple, somewhat flat, quadratic chamber.

The buccal stomach or œsophagus ("gaster buccalis," *ga*)—the "oral funnel" of Fritz Müller, "oral peduncle" of Claus—is comparatively small in our species, and forms a flat quadrate pyramid. Its truncated point is formed by the narrow palatine opening (fig. 9, *gp*), its angles by the four perradial strong oral ribs, thickened selvages of the gelatinous plate, which gives consistence to the whole stomach. The oral ends of these buccal ribs project considerably at the quadrate oral opening, and cause the formation of the four lanceolate or oval "oral lobes." A deep perradial groove runs on the axial endodermal surface of these frilled triangular oral lobes; it bends with a sharp turn towards the outside at the palatine opening, and runs, enclosed in the mesogonial fold, on the inner surface of the subumbral wall of the central stomach as far as the middle line of the radial pouch (figs. 4, 6, *gs*). The thickened oral rib itself, which at the same time forms the midrib of the leaf-shaped many-folded oral lobe, runs at the palate immediately into the low mesogonial fold. The folded oral tubes, which were strongly contracted in our spirit specimen and appear thickly frilled at the margins, are probably capable of greater expansion in the living animal.

The central stomach in this *Charybdea*, as in most Charybdeidæ, is joined to the basal stomach, as the pyloric stricture between the two is not developed and only faintly indicated by the slightly projecting pyloric valves. These two divisions of the stomach therefore compose a wide, but very flat pouch, or a low chamber, quadratic in outline. Its bottom or lower wall represents the thin quadrate plate, which at the same time forms the fundus of the cubic umbrella cavity. This muscular plate is pierced in the middle of the palatine opening, from whose four perradial corners the gastral grooves already mentioned (figs. 4, 6, *gs*), run to the middle of the four gastral openings. The horizontal cover of the low gastral chamber or its upper wall is formed by the smooth endodermal surface of the cap-shaped umbrella apex (figs. 2, 3, *gu*). The four interradial corners are occupied by the four pyloric valves, the narrow "bow-shaped fused lines" (Claus), which are placed perpendicularly at the proximal ends of the long septal selvages. On the other hand, the four perradial side walls of the chamber between the selvages are represented by the four gastral openings (fig. 6, *go*), four narrow horizontal clefts, which lead from the stomach into the four radial pouches. We find here a complicated arrangement of valves, by means of which the stomach can be completely shut off for a time from the radial pouches, These four perradial "pouch-valves" alternate with the interradial pyloric valves (*gy*). Above each pyloric valve the stomach forms a peculiar evagination in the form of a low triangular pouch, and the phacelli or dendritic bunches of gastral filaments (*b*) are placed in this pyloric pouch.

The gastral filaments (fig. 7, *f*), are much more strongly developed in *Charybdea murrayana* than in the closely-allied *Charybdea marsupialis;* in each of the four interradial corners of the stomach they form a visible phacellus or bush, composed of ten to twelve larger and several smaller branches. The stems of these branches are connected below at the root, where they rise from the aboral surface of the subumbral pyloric valve, and so actually represent the principal branches of a single, very short, powerful stem, a primary interradial primitive filament. The lower (distal) half of each branch consists of a strong, simple, or bifurcate stem, the upper (proximal) half of a pencil-shaped bunch of numerous branches, which are partly simple, partly dichotomised (figs. 9, 10). The solid axis of the filaments is formed by a thick cylindrical or flat ribbon-like gelatinous filament (a process of the supporting plate of the subumbrella); its endodermal epithelium is mostly composed of gland cells, having many flagellate cells at the base and urticating cells at the point.

The four broad quadrangular radial pouches (figs. 2–6, *bp*), occupy the greater part of the subumbrella, and are only separated from each other by four narrow interradial septal selvages (*ks*). These correspond to the septal nodes of the Tesseridæ and Peromedusæ, and to the septal selvages of the Lucernaridæ; and, like the latter, have arisen by fusion of the umbral and subumbral wall of the primitive stomach of the Scyphostoma, ("cathamma," *k*). The remains of the gastral epithelium are therefore visible in the transverse section of the selvages, in the form of the "endodermal lamella, cathammal plate, or vascular plate" (fig. 10, *kp*), which separates the thicker gelatinous disc of the umbrella (*ug*), from the thinner supporting lamella of the subumbrella (*zw*). We can even distinctly distinguish two layers of cells in the gastral plate, of which the outer belongs to the umbral endoderm, the inner to the subumbral endoderm. A leaf-shaped genitalium, which projects freely into the contiguous radial pouch, is fastened along the entire length of the septal selvages on each side of its subumbral part (fig. 10, *s*).

Four margins and two walls can be distinguished in each radial pouch. Whilst the two lateral margins of the quadrangular pouch are formed by the interradial septal selvages, its lower (or distal) margin is the proximal velar margin and its upper (or proximal) margin is the gastral opening. The latter can be completely closed by the perradial pouch-valve; this is formed by a horizontal fold of the subumbrella, which rises at the upper margin of the pouch and projects as a thickened gelatinous plate freely into the cavity of the basal stomach. The external or abaxial wall of the radial pouches is formed by the smooth endodermal surface of the gelatinous umbrella, its inner or axial wall by the delicate subumbrella. The latter is thin-walled and very extensible, and consists from within to without of the usual four layers:—(1) The endodermal epithelium with high, glandular, cylindrical cells (fig. 10, *dw*); (2) the thin but firm supporting plate or gelatinous lamella (*zw*); (3) the muscular plate (*mw*); and (4) the exodermal epithelium (*qw*). Although pretty firm, the subumbral wall is so thin that it stretches, like a delicate veil, above the pouches, and allows all the organs lying in them to shine clearly through. A narrow band-shaped longitudinal muscle (fig. 3, *mp*) runs in its perradial middle line. This muscle passes above into the "mesogonium," or upper supensory, below into the "frenulum velarii," or lower supensory. The latter divides the distal section of each of the radial pouches into two broad adradial lobe pouches.

The eight lobe pouches or marginal pouches ("bursæ lobares," or "marginales," figs. 2, 3 8, *bm*) are caused by a perradial septum, which, running from each rhopalar niche to the upper velar margin, divides the distal part of each radial pouch into two halves. This septum is merely the abaxial margin of the frenula itself in which the umbral and subumbral walls of the pouch are fused together. Each of the marginal pouches thus formed is rectangular, nearly twice as broad as high. Dendritic, cæcal, velar canals run from their lower or distal margin into the "velarium" (fig. 8, *cv*). These lie entirely in the thickened supporting lamella of the velarium, and are flattened like a ribbon; their endodermal epithelium, like that of the radial pouches, is flat and clear on the umbral side, high and glandular on the subumbral. Their ramification is delicately dendritic and is weaker towards the perradius, stronger towards the interradius. There are forty-eight velar canals on the whole, so that twelve of them come on each quadrant. The largest velar canal lies nearest the interradial pedal and shows 6 to 8 pairs of side branches, partly simple, partly cleft. On the other hand, the number and size of the irregular side branches increases at intervals towards the frenulum (fig. 8). The velar canals lie freely in the gelatinous fulcral lamella of the velarium. and are not connected by a cathammal plate; they are therefore secondary formations, which have subsequently grown with the solid supporting plate of the velarium from the distal margin of the lobe pouches.

The four perradial rhopalar canals (or ocular vessels) arise by a funnel-shaped basis from the middle line of the radial pouches above the velar frenula, and pass, narrowed, immediately into the peduncle of the sense club, in whose free head part they end in an ampulla-shaped expansion. The four tentacle canals (or the pedal canals leading into the tentacles) arise at the four interradial angles of the umbrella by a double root, as each tentacle receives a root canal from the distal corner of each quadrangular radial pouch. Each pouch therefore gives out two root canals for two adjacent tentacles. The junction of the two root canals takes place immediately below the distal end of the septum. The tentacle canal proceeding from it traverses the entire length of tentacle, and is comparatively very narrow, owing to the thickness of the tentacle wall. A kind of marginal circular canal is formed by the communication of the radial pouches, which is produced at their distal margin by the root canals.

The genitalia (Pl. XXVI. figs. 2, 6, 10, *s*) form eight broad, thin, semi-oval leaves which are fastened in pairs along the four interradial septal selvages, and project freely from these into the four radial pouches; they occupy the greater part of their hollow space so that the two reproductive leaves of each pouch touch each other or even overlap with their free margins in its middle (fig. 2, *s*). Claus sees in this formation "a very peculiar arrangement" (1879, Zoologie, p. 289). The difference presented between the reproductive glands of the Cubomedusæ, and those of the other Acraspeda, is, in fact, only insignificant; and the former may easily be referred back to the latter. Most Lucernaridæ show the same conditions in the broader anatomical sense, as in these two genitalia come upon each of the four broad radial pouches. These, however, do not belong to the said pouches, but rather to the interradial septum, which separates each two pouches. The two genitalia, which belong to two adjacent pouches and are separated by a septum, form one pair, and in *Halicyathus*, as in *Tesserantha* (Pl. XV.), are connected into a horse-shoe by a convex arch at the proximal end of the septum. In the remaining Lucernaridæ (Pls. XVI., XVII.) this U-shaped connective arch has undergone retrograde formation, so that eight separate adradial reproductive leaves lie beside each other, and this holds good for the Peromedusæ and Cubomedusæ. In all cases, likewise, the reproductive elements are formed from the subumbral endoderm of the radial pouches (fig. 10, *rw*). Then the reproductive leaves are fastened to the septum in such a way that they touch the umbral wall immediately; but as they are completely separated from it by the cathammal plate of the septum (*ks*), they belong genetically to the subumbral wall. Each reproductive leaf is really a thin fold of this subumbral wall, inasmuch as the gelatinous supporting lamella of the latter forms a leaf-shaped process ("sterigma," fig. 10, *zs*), which is covered on both sides by the subumbral endodermal epithelium. The reproductive elements, which fall freely when ripe into the pouch, are developed from the subumbral endodermal epithelium on both sides of the sterigma. They originate from the subepithelial endoderm cells, which cover both surfaces of the fulcral process. The latter corresponds to the sterigma or fulcral frame in the genitalia of the Peromedusæ (p. 83), and formed in both female specimens before me a broad, fibrous, axial plate (fig. 10, *zs*), thickly covered with later and earlier egg cells (*so*). The reproductive leaves are covered on both free surfaces by the connected cylindrical epithelium of the endoderm (fig. 10, *pd*). The ripe reproductive elements pass from the radial pouches into the stomachs through the gastral openings, and are expelled through the mouth.

Order VIII. DISCOMEDUSÆ, Hæckel, 1866.

Acraspeda with eight to sixteen or more sense clubs (always four perradial and four interradial, besides these occasionally several accessory clubs); in each sense club an auditory club with an endodermal otolite sac and often an eye at the same time. Marginal lobes always eight pair of primary (Ephyra lobes) and frequently numerous accessory (velar lobes) besides. Tentacles sometimes present, sometimes wanting. Stomach surrounded by a corona of radial processes (8 to 16 to 32 or more; sometimes broad radial pouches, sometimes narrow radial canals. Genitalia four interradial folded swellings in the subumbral gastral wall, developed from its endoderm (rarely divided into eight adradial swellings); sometimes invaginated in the form of a pouch towards the inside in the central gastral cavity, sometimes evaginated hernia-like towards the outside in the umbrella cavity. Umbrella depressed and discoid. The general fundamental form of all Discomedusæ is the octomeral Ephyra.

First Sub-order of the Discomedusæ, CANNOSTOMÆ, Hæckel, 1879.

Discomedusæ with undivided proboscis or oral tube, a simple, quadrangularly prismatic œsophagus, without oral arms; with simple or quadrangular central oral opening, and with short, solid marginal tentacles.

Family, Ephyridæ, Hæckel, 1877.

Ephyridæ, Hæckel, System der Medusen, 1879, taf. xvii., xviii., p. 450.

Cannostomæ with broad radial pouches, without terminal branched canals. Discomedusæ with simple, quadrangular œsophagus, without oral arms; with simple oral opening, usually sixteen broad radial pouches (eight ocular and eight tentacular), more rarely 32 to 64. Usually eight sense clubs (four perradial and four interradial), more rarely 16 to 32. Alternating with these an equal number of short, solid tentacles. Usually 16 (rarely 32 to 64) marginal lobes, with or without simple lobe pouches, always without branched lobe canals; four interradial or eight adradial genitalia in the subumbral gastral wall.

Sub-family, NAUSITHOIDÆ, Hæckel, 1879.

Ephyridæ with eight sense clubs and eight adradial tentacles, with sixteen marginal lobes and eight separate adradial genitalia.

Nauphanta,[1] Hæckel, 1879.

Ephyrid with eight sense clubs and eight tentacles, with sixteen marginal lobes and thirty-two lobe pouches (sixteen ocular and sixteen tentacular). Central stomach opened by four perradial gastral openings into a ring sinus, from whose distal margin run out sixteen coronal pouches; eight separate adradial genitalia, equally distributed, not grouped in pairs.

The genus *Nauphanta* is, as yet, represented only by the remarkable deep-sea Medusa described below. It is most closely allied to the Mediterranean *Nausithoë* among all Medusæ hitherto known, but is distinguished from it by peculiar conditions of structure. The sculpture of the exumbrella with its deeply insected coronal furrow between the central disc and the peripheric corona, and with the very prominent pedalia (polyhedric gelatinous swellings between the radial furrows) reminds us strikingly of the Periphyllidæ and Collaspidæ; in other respects it appears to be a very old intermediate form connecting among Peromedusæ, Cubomedusæ, and Discomedusæ; as it is closely related morphologically to all these groups, it indicates the common descent of the Ephyroniæ and Tesseroniæ. *Nauphanta* takes the highest place among the three genera of the Nausithoidæ, and represents the most highly developed form among the octomeral Ephyridæ. In many respects it approaches the following polymeral Collaspidæ. It agrees with the closely-allied *Zonephyra* and *Pelagia* in having thirty-two lobe pouches, whilst it differs from them both in the formation of the reproductive organs. These comport themselves the same as in *Nausithoë*, and form eight roundish adradial sacs, similar in form and at equal distance from each other. The two specimens before me, a male and a female, are perfectly mature. The ovaries are eight tuberous, scutiform plates, whose endodermal upper surface is covered with very large ova. Instead of these plates the spermaria form numerous digitate spermatic sacs. The developed pedalia of the corona of the exumbrella remind us of the Peromedusæ (*Periphylla*) on the one hand,

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[1] Ναυφάντη, the name of a ship in Aristophanes.

and of the Collaspida (*Atolla*) on the other. Like *Atolla, Nauphanta* is a true deep-sea form of high phylogenetic antiquity.

Nauphanta challengeri, Hæckel (Pls. XXVI., XXVII.).

Nauphanta challengeri, Hæckel, 1879, System der Medusen, p. 487, No. 452.

Umbrella cap-shaped, with a horizontal apical surface, and vertical side-wall, one and a half times as broad as high. Exumbrella with a deep coronal furrow and sixteen deep radial furrows. Umbrella corona with sixteen pedalia (eight smaller rhopalar and eight stronger tentacular); sixteen marginal lobes oval, nearly twice as long as broad, with a deeper peronial furrow, about one-fourth as long as the radius of the umbrella. Tentacles cylindrical, pointed, about as long as the radius of the umbrella. Genitalia eight oval, adradial, kidney-shaped swellings, twice as long as broad; their proximal halves somewhat broader than their intervals, their distal halves covered by the coronal muscle. Horizontal diameter, 12 mm.; vertical diameter, 8 mm.

Habitat.—The South Atlantic Ocean, not far from the island of Tristan da Cunha. Lat. 32° 24′ S., long. 13° 5′ W. Depth, 1425 fathoms. Station 335. Both specimens examined (a male and a female) are well preserved, and were taken on 16th March 1876. The transverse and longitudinal sections figured are taken from the two halves of the halved female specimen.

The umbrella (Pl. XXVII. fig. 1; Pl. XXVIII. figs. 12–14) of *Nauphanta challengeri* has the form of a cap or biretta, and is considerably more vaulted than in most other Discomedusæ. Its special conformation, and especially the peculiar sculpture of the exumbrella, reminds us in many respects of the Cubomedusæ and Peromedusæ, with which the oldest ancestral forms of the Discomedusæ are clearly very closely allied. Whilst the upper flattened apical surface appears almost horizontal, the steep, vertical side walls stand almost vertical. The umbrella is constricted between the first or second third of its height by a deep horizontal coronal furrow ("fossa coronalis," *ec*), and is thereby divided into an upper (central) umbrella disc, and a lower (peripheric) umbrella corona. The umbrella disc ("discus umbrellæ"), which is depressed above like a cup in the middle, forms the horizontal cover of the flat discoid basal stomach (*gb*); the umbrella corona ("corona umbrellæ") encloses the corona of the radial pouches, and bears below at the margin the corona of the tentacles, and rhopalia, and the marginal lobes alternating with them.

The exumbrella (figs. 1, 13) is distinguished by the horizontal coronal furrow (*ec*), and also by deep, radial, or longitudinal furrows, which, as in *Periphylla* (Pls. XIX., XX.), divide the external surface of the umbrella into convex, projecting, gelatinous swellings. We can distinguish on the whole sixteen deep, subradial, longitudinal furrows, and sixteen shallower, alternating with them. The latter traverse nearly the whole exumbrella and touch both the umbrella disc and the umbrella corona, whilst the deeper subradial furrows are confined to the umbrella corona. Of the sixteen shallow, longitudinal furrows, four are perradial, four interradial, and eight adradial. They are placed at equal distances in the central umbrella disc, and divide its peripheric, thickened half into sixteen equal, subradial disc-swellings, whilst its thinner central half remains without furrows, and is, at the same time, considerably thinned away (figs. 1, 13, 14). In the peripheric umbrella corona, on the other hand, they are only distinctly impressed in the distal part of the sixteen coronal swellings. The deeper sixteen subradial longitudinal furrows, which traverse the entire corona of the umbrella, lie between the sixteen coronal swellings, and are placed in pairs in such a way that the umbrella corona is divided into eight narrower and eight broader gelatinous sockels or pedalia; the former bear the eight rhopalia, the latter the eight tentacles (figs. 1, 13). Each of the sixteen gelatinous sockels consists of a thicker, undivided proximal part and a thinner distal part, halved by a shallow, radial furrow; the former contains a coronal pouch, the latter a pair of lobe pouches. The eight narrower, principal ocular sockels (" pedalia rhopalaria "), four perradial (*up*), and four interradial (*wi*), are distinguished by their side lines being sinuated concavely, and their narrower proximal part being only half as long as the bifurcate distal part. The eight broader adradial tentacular sockels ("pedalia tentacularia," *ww*), on the contrary, show convexly projecting side lines, and their broader proximal part is nearly twice as long as the deeply inserted distal part (figs. 1, 13). The ends of the bifurcate halves are rounded obtusely in all sixteen pedalia, and sharply defined from the marginal selvage of the marginal lobes ("patagium," *lp*).

The subumbrella (figs. 12, 13) is divided into three sections by the broad coronal muscle (*mc*), by whose two margins they are separated from one another. Its inner or upper intracoronal third reaches from the insertion of the stomach (relatively from the four pyloric valves or interradial septal nodes) as far as the inner or proximal margin of the coronal muscle (*mc*), and contains both the proximal halves of the eight adradial genitalia (*s*), and the narrow longitudinal deltoid muscles alternating with them; of these muscles, as in *Atolla* (Pl. XXIX.), the four interradial (fig. 12, *md*) are much stronger and broader than the four perradial (fig. 12, *md*). The middle or coronal third of the subumbrella is occupied solely by the broad coronal muscle ("musculus coronalis," figs. 12, 14, *mc*). This comports itself precisely as in *Periphylla*, and is divided by the sixteen fused clasps of the marginal lobes (fig. 12, *kl*) into sixteen quadrangular coronal areæ. Of these the eight adradial (tentacular) are considerably broader than the eight principal (rhopalar); the former cover, at the same time, the distal halves of the genitalia on their axial side. The external or lower extracoronal third of the subumbrella extends from the outer or distal margin of the coronal muscle (mc_4) to the actual margin of the umbrella, and is occupied by the corona of lobes. In it we can distinguish sixteen pairs of longitudinal lobe muscles, a pair for each marginal lobe.

From the umbrella being so much vaulted, the umbrella cavity (*w*) is more spacious and higher than in most other Discomedusæ. It is nearly cylindrical in form, as its subumbral side walls rise nearly perpendicular (fig. 14). But as the eight genitalia project like arches towards the inside, it is rather octangularly prismatic. Its upper base is occupied by the subumbral bottom of the stomach (*gw*), its lower bases by the wide opening of the umbrella, surrounded by the corona or marginal lobes. The axial middle space of the proximal half is filled by the pendant œsophagus. The subumbral gastral wall forms four narrow mesenteric folds or mesogonia in a radial direction above, and projects further between them in an interradial direction, so as to form four flat, interradial funnel cavities (fig. 3, *ii*); these are covered over by the four flat pyloric valves (fig. 2, *gi*), which bear the phacellæ (fig. 2, *f*). The special formation of this part is very similar to that of many Cubomedusæ (Charybdeidæ).

In *Nauphanta*, as in Ephyra, the common ancestral form of all Discomedusæ, and in most genera of the family Ephyridæ (all Palephyridæ and Nausithoidea), the umbrella margin (Pl. XXVII. fig. 1; Pl. XXVIII. figs. 12–14) is regularly composed of the following marginal organs:—Eight rhopalia (four perradial and four interradial), eight adradial tentacles alternating with these, and sixteen subradial marginal lobes, inserted between the rhopalia and the tentacles. The number of the sixteen marginal organs, which alternate with the sixteen subradial marginal lobes, is therefore the same here as in *Tesserantha* (Pl. XV.) and *Periphylla* (Pl. XVIII. &c.). Whilst, however, in the Stauromedusa *Tesserantha* all the sixteen marginal organs remain simple tentacles, and in the Peromedusa *Periphylla* the four interradial tentacles are transformed into rhopalia, in our Ephyrida only the eight adradial tentacles appear to be permanent; the eight principal tentacles (four perradial and four interradial) are transformed into the characteristic sense clubs, as in all other Discomedusæ.

The eight sense clubs or rhopalia (figs. 12, 13, *cr*; fig. 20) resemble most strongly those of the most closely allied *Nausithoë*, among all known forms of these organs, though they also agree in many and most important points with those of *Periphylla* (Pl. XVIII.). They are distinguished from those of most other Discomedusæ by their broad, succinct shape. The eight sense clubs lie hidden between each pair of marginal lobes in four perradial and four interradial deep incisions of the umbrella margin, which alternate with the deep tentacular incisions (figs. 12–14). Each rhopalium has, on the whole, the form of a broad tongue-shaped leaf, and is nearly one and a half times as long as broad. In the normal position of the vertical umbrella margin, its free distal end is directed upwards in such a way that the convex abaxial surface looks freely outwards, the concave axial surface freely inwards towards the umbrella cavity. Of the four sense organs which are united in each rhopalium, the olfactory depression lies on the convex external side of the basal part, the eye opposite on its concave internal side, the tactile plate below the eye, and the free auditory club hidden in the spacious auditory niche (fig. 20, *on*). The olfactory depression or olfactory funnel ("infundibulum olfactorium," *oz*) forms a flat conical depression in the convex exumbral side of the thickened basal part; its endodermal epithelium is laid in delicate folds, and consists of rod-shaped sense cells (olfactory cells?). Opposite it, on the concave subumbral side, there is a broad black brown pigmented pad (fig. 20, *op*), in whose centre the unpaired axial eye lies embedded, as in *Nausithoë*; this seems to contain a concave-convex lens in the middle of a darker pigmented knob (*oc*). Below the knob a narrow dark pigmented band runs out, which projects more strongly convexly, bears a variously shaped epithelium with long tactile hairs, and probably represents a tactile plate (*op*). The auditory club (*ok*) rises on a thin stalk outside this plate (on its abaxial side); it hangs freely down in the concave rhopalar niche (*on*), and is surrounded protectively towards the outside by the broad concavo-convex protective scale or auditory scale (*os*); the blunt lower margin of the latter is folded over above towards the inside. The solid auditory club, whose ectodermal epithelium bears long auditory hairs, encloses a spheroidal or subspheroidal otolite (fig. 20, *ol*; fig. 21) in its free swollen distal end. This otolite is crystalline, and transparent and shows many irregular, polygonal, slightly convex facets, as well as a sharply projecting granulation on its upper surface. Several smaller otolites seem added to the larger one at the proximal end.

The eight tentacles (*t*), which alternate with the eight rhopalia, and therefore lie adradially, spring further above in deeper incisions of the umbrella margin. They are nearly as long as the height of the umbrella, cylindrical, pointed like an awl at the distal end, and swollen to a cone at the proximal basis. A short canal (a branch of the eight adradial coronal pouches) runs some way into the basal part of the tentacles which otherwise are solid. Their principal mass forms a soft, elastic, chordal axis, composed of large vesicular endoderm cells. The ectodermal covering consists partly of thread cells, partly of tactile cells, and partly of epithelial muscular cells. The long muscular fibres of the latter run longitudinally and form a strong longitudinal muscle on the axial side of the tentacles.

The sixteen marginal lobes (*lm*) lie subradially, in the middle between the eight adradial tentacles and the eight alternating rhopalia. They are obliquely oval, with unequal sides, as their tentacular margin is nearly twice as long as their rhopalar margin. Each marginal lobe is considerably thickened in its proximal half, by the inverted bifurcate branches of each two adjacent pedalia, whilst its distal half is formed by a very delicate, thin-membraned, almost triangular patagium (*lp*).

The gastrovascular system (Pl. XXVII. figs. 2–10; Pl. XXVIII. figs. 12–15) of *Nauphanta* appears at first sight very simply formed, and not essentially different from that of *Ephyrula*, the known common germinal form of the Discomedusæ. On closer investigation, however, it shows several very remarkable and important conditions of formation not to be found at the present day in the majority of Discomedusæ, and which may be considered extremely old peculiarities inherited from the common ancestral form of the Acraspedæ. In this way *Nauphanta* comes nearer the Tesseroniæ than the other Ephyroniæ, and connects these two sub-sections of the Acraspedæ in a most interesting fashion; above all, it is remarkable in one respect, that the four important interradial septal nodes or cathamma which separate the four broad perradial gastral pouches and which have disappeared entirely in most Discomedusæ, still exist here. The reproductive glands lie in the subumbral wall of the coronal intestine below the septal nodes (much further, therefore, towards the exterior than in most other Discomedusæ). But in the peculiar nature of the central principal intestine, and also in that of the peripheric coronal intestine, we find manifold peculiarities which recall the Tesseroniæ more than the Ephyroniæ, and which must be regarded as very ancient heirlooms from the common ancestral form of the two sections.

The axial principal intestine ("gaster principalis," figs. 2–7) appears at first sight to consist, as in the other Discomedusæ, of two principal sections, of the upper (aboral) central stomach and the lower (oral) buccal stomach; the former is covered by the umbrella disk, and is itself flatly discoid; the latter is more funnel-shaped, and hangs freely down in the umbrella cavity. The buccal stomach is, however, constricted in the middle; this stricture probably corresponds to the palatine opening ("porta palatina," *gp*), in which case we can probably still distinguish here all the three gastral chambers of this section of Medusæ. The boundary between the two principal sections is formed by the horizontal cathammal plane, in which the four septal nodes or cathamma (*kn*) are placed; these may be considered the pyloric opening ("porta pylorica," *gy*). Otherwise the three gastral chambers have an extremely simple formation. If the foregoing supposition be correct, the buccal stomach or œsophagus ("proboscis") is limited to the oral half lying below the palatine opening (*gp*), which has the form of a truncated quadrangular pyramid. The base of the latter is formed by the quadrate oral opening, from whose four corners the four perradial short triangular oral lobes project (figs. 12, 14, *al*). It only extends as far as the proximal margin of the coronal muscle; consequently the œsophagus only occupies the upper half of the umbrella cavity. Above the palatine opening (*gp*), the stomach is again dilated in the form of a flat funnel, corresponding to the true central stomach (*gc*). This funnel opens above immediately into the flat basal stomach (*gb*), and appears only separated from it by the four interradial pyloric valves ("vavulæ pyloricæ," *gi*). These are four flat tongue-like projections, which stand out centripetally from the four septal nodes in the base of the stomach, and bear the gastral filaments at their upper free end (fig. 14, *f*); they completely correspond to the stronger pyloric valves of many Cubomedusæ (p. 98). The ideal horizontal plane, in which they lie, corresponds to the pylorus of the Tesseroniæ, and therefore actually forms the lower boundary surface of the basal stomach, whose upper surface is formed by the horizontal, almost level, endodermal surface of the central gelatinous disc of the umbrella (fig. 14, *ng*).

The four septal nodes ("nodi cathammales," fig. 3, *kn*; fig. 14, *kn*) are four, interradial, small but firm nodules, hard as cartilage, in which the subumbral gastral wall is firmly fused with the umbral. Four broad horizontal clefts remain between the nodes, the four perradial gastral openings, by which the central stomach communicates with the peripheric coronal intestine. These important conditions of organisation correspond clearly to those of the Tesseroniæ. The four important interradial cathammal nodes especially, as well as the ring sinus lying beneath them, are homologous with those of the Peromedusæ; whilst on the other hand the condition of the four interradial tongue-shaped pyloric valves shows a special homology with many Cubomedusæ. In most other Discomedusæ (certainly in all *Semostomæ* and *Rhizostomæ*) these Tesseronia-like formations have disappeared, as the septal nodes and the pyloric valves have undergone retrograde formation.

The gastral filaments (Pl. XXVIII. fig. 18) are not very numerous, but comparatively large and thick. They are four arched interradial phacellæ, whose convex margin corresponds to the free margin of the tongue-shaped pyloric valve (*gi*). Each crescentic phacella consists of a single row of from twenty to twenty-four gastral filaments, placed closely near each other. They are cylindrical, and decrease in length from the middle of the phacella towards the two ends, the longest one nearly one-third as long as the radius of the umbrella.

The peripheric coronal intestine ("gaster coronaris") extends from the horizontal cathammal plane of the four septal nodes (which lies a little above the exumbral coronal furrow), to the umbrella margin and consists of the following three coronal or horizontal sections: A, a proximal or upper corona of four perradial gastral pouches; B, a middle corona of sixteen coronal pouches; and C, a distant or lower corona of thirty-two marginal lobe pouches. On closer examination we can even distinguish five different sections of the coronal intestine, as there is also a special coronal sinus (*cs*) between the four perradial principal pouches and the sixteen coronal pouches, and below it an intercalary corona of eight pouches (fig. 4). Compare the transverse section (figs. 2–10) and the longitudinal section (figs. 14, 15).

The four broad radial pouches, or perradial gastral pouches (fig. 4), which belong to all Tesseronia, are undeniably also present here, or are at least represented by the four gastral openings or broad cleft spaces between the four interradial septal nodes (*kn*). We may also include with these the circular hollow space below the septal nodes, between them and the proximal margin of the coronal pouches, unless we prefer to compare this hollow space to a special coronal sinus (*cs*, fig. 14), like that of the Peromedusæ ("sinus coronaris," p. 79, Pl. XXI., *cs*). In fact the conditions here are the same as in all those Tesseroniæ, whose interradial septa or cathammata are merely small short nodes, not long selvages.

The sixteen coronal pouches ("bursæ coronares") which form the middle zone of the coronal intestine, go out from the distal margin of the coronal sinus; they are alternately broader and narrower, and are divided from each other by the sixteen subradial septal selvages, which form the proximal processes of the sixteen subradial lobe clasps (figs. 4–15, *kl*). Their inner or axial wall forms below the sixteen coronal areæ of the coronal muscle, its outer or abaxial wall the sixteen pedalia of the umbrella. Each coronal pouch divides below (at the distal margin of the coronal muscle) into three cæcal terminal branches, of which the two lateral enter the inverted halves of the two adjacent marginal lobes, whilst the middle passes either into a rhopalium or into a tentacle. The eight narrower ocular pouches (*bo*) (four perradial and four interradial) extend to the eight rhopalia, in whose ampullæ their middle terminal branch ends cæcally. The eight broader tentacle pouches (*bt*) are much wider, and contain the distal halves of the genitalia, which are fastened to their subumbral wall; their middle terminal branch passes into the basal part of the tentacles; they project a considerable way into the umbrella cavity (figs. 5, 6). Of the eight ocular pouches, the four perradial are somewhat longer than the four interradial, as they spring from the coronal sinus rather higher up than the latter. This explains how in the transverse section of the umbrella only eight radial pouches appear immediately below the simple coronal sinus (fig. 4). The four narrow, perradial ocular pouches (bo_1) alternate with four very broad wide pouches (br_2) which contain the upper proximal ends of a pair of genitalia; rather further down they divide into three pouches, a middle interradial ocular pouch and two lateral adradial tentacular pouches (fig. 5). This comportment of the coronal pouches is best seen by comparative consideration of the longitudinal section (figs. 14, 15) and the transverse section (figs. 3–8). It is also worthy of remark that the subumbral endoderm of the ocular pouches rises into high papillæ and folds, corresponding to the sterigma of the tentacular pouches (figs. 4–8).

The thirty-two lobe pouches ("bursæ lobares," *bl*) fill in pairs the proximal half of the sixteen marginal lobes, whilst the delicate thin-membraned distal half of the lobes remains free (figs. 12, 14, *bl*). The two pouches of each lobe are separated by the subradial lobe clasp (*kl*) and belong to two different adjacent coronal pouches, an ocular and a tentacular. As the rhopalia lie considerably deeper than the insertions of the tentacles, the sixteen ocular lobe pouches are much shorter than the sixteen tentacular lobe pouches. The distal ends of both lie, however, in the same horizontal plane. The peripheric corona of pouches in *Nauphanta*, therefore, shows essentially the same conditions of formation as in *Pelagia*.

The genitalia (Pl. XXVII. figs. 4–8, *s*; Pl. XXVIII. figs. 12–16, *s*) in both sexes form eight separate bean-shaped glands, lying regularly distributed internally on the subumbral wall of the coronal intestine, above the eight tentacles. More minute investigation, however, shows that they are associated in pairs, as in the Cubomedusæ and Peromedusæ. Consequently, there are really four interradial pairs of genitalia, present, which originally stood in immediate relation to the four septal nodes. We see clearly, especially from transverse sections, through the proximal halves of the ovaries, a little above the coronal muscle, that the eight genitalia really form four interradial pairs which have been developed from the four interradial septal nodes. Each pair of genitalia lies in a broad interradial pouch (br'), where the four interradial ocular pouches are still united with their two tentacular pouches (fig. 4); and rather further down, the sterigma of the two associated genitalia are curved and rolled inwards in such a way that their convex, lobed upper surfaces are turned towards one another. The two reproductive glands of each pair consequently correspond to arched halves of the four interradial genitalia of *Tesserantha*. The form both of the ovaries and the spermaria in *Nauphanta* is bean-shaped or kidney-shaped, concave on the axial side, convex on the abaxial. They extend above into the coronal sinus, near the septal nodes with the uppermost parts of their truncated proximal half, whilst they almost touch the distal margin of the coronal muscle and the tentacle basis, with the lowermost part of their thinner distal half. The two halves are separated externally from each other by the proximal margin of the coronal muscle (figs. 12, 14, *mc*), which stretches like a veil above the lower half. At a superficial view, it seems as if the genitalia lay in the subumbral wall of the coronal intestine, and from thence form projecting pouches in the umbrella cavity. Comparison of longitudinal and transverse sections shows, however, that for the most part, they lie freely in the hollow space of the tentacular coronal pouches and are only connected with their subumbral wall at a node-like point, which we shall call the genital root (figs. 4–11, 15, st_1). The fulcral frame ("sterigma"), bearing the endodermal germinal epithelium, runs out at this root from the gelatinous supporting lamella of the subumbrella.

The sterigma (*st*) or the fulcral frame of the genitalia runs out from the root as a short, thick cone; it immediately extends in the shape of a thin, strong, arched shield, having many folds, and bearing numerous irregularly-formed hollow papillæ on its convex upper surface. This fulcral frame of the genitalium then appears branched dendritically both in the transverse and the longitudinal sections (4–11, fig. 15), it corresponds to the pinnated genital rib of the Peromedusæ (" sterigma," p. 83, Pl. XXIII. fig. 38). The node-like root of the sterigma is crescentic, cut out concavely at the upper or proximal margin. At the same time, it is hollowed out by a cæcal arching outwards of the coronal pouch, in such a way that in the transverse section (fig. 6) it seems to begin with two separate radical branches, which are the two horns of the crescent (st''). The shape of the sterigma is, therefore, really very complicated (figs. 2–15). The cartilaginous connective tissue, which forms the fibrous stroma of the sterigma, has numerous cells, especially towards the endodermal upper surface. As the sterigma is only connected with the subumbrella at its thin root, it otherwise projects freely into the hollow space of the coronal intestine, extending into the coronal sinus with the proximal half, and into the eight tentacular coronal pouches with the distal half. The sterigma is covered on its convex outer surface by the usual endoderm of the subumbral wall of the coronal intestine. On the concave inner surface, which encloses a genital sinus with repeated archings-out, this endoderm is transformed into germinal epithelium, which forms reproductive elements.

The germinal epithelium of the endoderm (fig. 16, *ds*), which forms large egg cells in the female, and spermatic follicles nearly twice the size in the male, is found exclusively on the concave inner surface of the shell-shaped, bent-in fulcral shield, as lining of the genital sinus enclosed by the shield. The sinus has a very complicated form, as the scutiform sterigma is turned over concavely, not only at its abaxial (outer), but also at its lateral surfaces, so that it is repeatedly arched outwards. The folded-over, concave, axial half is, moreover, fused for the most part with the convex abaxial half in such a manner that only a narrow passage leads from the hollow space of the coronal intestine into that of the genital sinus. This narrow passage is the "apertura sinus genitalis" (*sa*); it is difficult to find, and appears both in *Nauphanta* and in *Atolla* to lie turned towards the two genitalia belonging to an interradial pair, at the interradial side of the sterigmal root. This aperture was the more difficult to find in the two preserved spirit specimens, as the hollow space of the sinus was almost entirely filled with coagulated slime (?), and the epithelium in great part destroyed. Both the ripe egg cells and the ripe balls of spermatozoa pass from the germinal epithelium into the gelatinous plate of the sterigma, and are enclosed here in thin-walled fulcral capsules. These burst later on, and the ripe reproductive elements probably do the same, then fall directly into the hollow space of the coronal intestine of the genital sinus, through whose aperture they are emptied into the coronal intestine, from thence by the gastral openings into the stomach and then outside through the mouth.

Sub-family, COLLASPIDÆ, Hæckel, 1879.

Ephyridæ, with 16 to 18 sense clubs, and the same number of tentacles, with 32 to 64 marginal lobes, and 8 separate genitalia.

Atolla,[1] Hæckel, 1879.

Ephyrida, with 16 to 32 rudimentary sense clubs, and the same number of tentacles, with 32 to 64 marginal lobes, and 64 to 128 lobe pouches. Central stomach opened by four perradial gastral openings into a coronal sinus, from whose distal margin run out 16 to 32 broad tentacular coronal pouches, and the same number of alternating rudimentary ocular canals; 8 separate adradial genitalia, grouped in pairs, not distributed at equal distances.

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[1] *Atolla* = an island surrounded by coral reefs.

The genus *Atolla*, like the preceding *Nauphanta*, is one of the most remarkable and morphologically interesting deep-sea Medusa brought to light by the Challenger expedition. Both are very ancient remains of an extinct ancestral group of Discomedusæ, which clearly indicate the close connection of this order with the Cubomedusæ and Peromedusæ. *Atolla* has a near relation in *Collapsis*, which is also an Antarctic deep-sea Medusa, and which I have described in my System der Medusen (1879, p. 489, taf. xxviii.). These two compose a special small group of deep-sea Cannostomæ, which I include provisionally as a sub-family of the Ephyridæ, but which it would be as well to separate in future as an independent family of the Collaspidæ. These two genera must be essentially looked upon as Ephyridæ, which are distinguished by their colossal size and peculiar complications in the formation of the umbrella corona, and the coronal intestine. The central umbrella disc, which is separated by a deep coronal furrow from the surrounding umbrella corona, has, on the whole, the same formation as in the Nausithoidæ, especially *Nauphanta*. The wide, but short, quadrangular œsophagus, cruciform in transverse section, is surrounded by eight genitalia, which in *Atolla* (as in *Nausicaa*) are grouped in pairs, whilst in *Collapsis* (as in *Nausithoë* or *Nauphanta*) they are adradially distributed at equal distances. The formation of the peripheric umbrella corona differs entirely, as it is distinguished both by the increased number of the marginal organs, and by special modifications of the structure. Whilst in all other Ephyridæ, Nausithoidæ, as well as Palephyridæ, the number of the sense clubs, tentacles, and pairs of lobes invariably amounts to eight, in the Collaspidæ it rises from sixteen to thirty-two, and seems to vary in the same way as it does in most polynemal Narcomedusæ. These remarkable Discomedusæ are altogether so like the polynemal Narcomedusæ that at first I took them for gigantic forms of the latter. Another peculiarity of the Collaspidæ consists in the extraordinary development of their coronal muscle. This is divided into two different, sharply defined wings, an inner or abaxial, which is delicate and thin like a velum, and an outer or abaxial, which is disproportionately thick and divided into from sixteen to thirty-two areæ. Immediately below it, at the basis of each short tentacle, there are two thick spindle-shaped radical muscles, like those in the Peromedusæ. The Collaspidæ also resemble the Peromedusæ strikingly in the sculpture of the exumbrella, as its coronal part is divided by deep furrows into thick polyhedral gelatinous pieces or pedalia. One half of these pedalia sustain the sense clubs, the other half support the tentacles. The sense clubs and the pouches belonging to them are small and scantily developed in *Collapsis*, and quite rudimentary in *Atolla*. This retrograde formation of the higher organs of sense is probably a consequence of adaptation to life in great depths of the sea. The formation of the coronal intestine is also very interesting and important, since it forms a wide coronal sinus in its proximal part, as in the Peromedusæ. This sinus, as in *Nauphanta*, communicates at its distal margin with the marginal corona of pouches, and at its proximal margin by four perradial gastral openings with the central stomach. This original arrangement has disappeared in most of the other Discomedusæ, as the four interradial septal nodes between the gastral openings have undergone retrograde formation, and the four perradial gastral pouches separated by them are therefore no longer present; both these and the coronal sinus have consequently become merged into the central stomach.

Atolla wyvillii, Hæckel (Pl. XXIX.).

Umbrella, quite flat, discoid, about six times as broad as high. Radius of the central umbrella disk almost twice as large as that of the peripheric corona of the umbrella; disk and corona separated by a very deep coronal furrow. Œsophagus, constricted in the middle, quadrangularly prismatic, two to three times as broad as high. Genitalia, eight elliptical pouches, grouped in pairs, in the periphery of the œsophagus, their perradial distances less than the interradial, 19 to 22 (16 to 32?) rudimentary sense clubs, and the same number of short tentacles (half as long as the radius of the umbrella) alternating with them. Tentacular pedalia broader and shorter than the rhopalar pedalia. Rhopalar canals rudimentary, much narrower and shorter than the tentacular. Marginal lobes elliptical and obtuse. Horizontal diameter of the umbrella, 58–66 mm.; vertical diameter, 10–12 mm.

Habitat.—Antarctic Ocean of the eastern and western hemispheres, in a depth of about 2000 fathoms. The Challenger captured five specimens of this remarkable species, which I was able to examine, preserved in spirits. The state of preservation was unfortunately only imperfect, in spite of the tough nature of the body, the epithelia being almost entirely wanting. All five specimens were mature females. Three of these were taken on 3d March 1874. Lat. 53° 55′ S., long 108° 35′ E. Depth, 1950 fathoms. Station 157, in the Antarctic Ocean nearly in the middle between the Kerguelen Islands and Melbourne. The two other specimens were taken 11th February 1876. Lat. 42° 32′ S., long 56° 27′ W. Depth, 2040 fathoms. Station 318, South Atlantic Ocean, St Mathias Bay, not far from the coast of Patagonia. Bottom temperature, 0·4° C. The three Indian-Antarctic and the two Atlantic-Antarctic correspond completely in structure and show no specific difference. The horizontal umbrella diameter in the first three (from Station 157) amount respectively to 66, 68, and 50 mm.; the diameter of the last two (from Station 318) to 40 and 38 mm. The smallest specimen of the latter (38 mm.) had only 19 tentacles and 19 pairs of lobes; all the four other specimens had 22 tentacles and 22 pairs of lobes. I have named this highly interesting species after Sir Wyville Thomson, the scientific director of the Challenger expedition.

The umbrella (figs. 1–4) of *Atolla wyvillii* forms a circular, thick, perfectly flat disk, nearly six times as broad as high; it is from 60–70 (more exactly 58–66) mm. in diameter, by 10–12 mm. in height. It is very firm in consistency, like cartilage. The exumbrella (fig. 1, fig. 4, right half) is divided by a broad, very deep coronal furrow (*ec*) into a central umbrella disk and a peripheric umbrella corona. The corona surrounds the disk as a wall does a fortress, or an atoll, a circular zone of coral reefs, does the island it encloses, from which it is separated by a ring of lagoons. The central disk ("discus umbralis," *uc*) is flat, smooth, circular, and gelatinous; its radius is nearly twice as great as the breadth of the umbrella corona, and therefore amounts to two-thirds of the whole radius of the umbrella. Its margin is divided by 19 to 22 radial indentations or incisions ("sulci radiales," *es*) into the same number of notches or teeth. These notches of the disk are quadrangular, 5 mm. broad and nearly as long; their height at the external perpendicular fall into the "mural ditch" amounts to 8 mm. The teeth lie in the same radii as the rhopalar pedalia (*uo*); they alternate with the tentacular pedalia (*ut*), which correspond to the radial furrows between the teeth.

The exumbral coronal furrow ("fossa circularis," *ec*) in *Atolla* is so deep, that in its fundus the central umbrella disk is only connected with the peripheric umbrella corona by a very thin gelatinous ring (fig. 4, *ec'*). Its depth amounts to 6–7 mm.; its greatest breadth (in the lower third) to 4 mm. It resembles a circle of lagoons, which separates the central island from the surrounding atoll reef, or the deep ditch which separates the enclosed fortification from its circular wall. But as the teeth of the umbrella disk, project towards the outside with their upper edge over the mural ditch, like overhanging cliffs, the upper, cleft-shaped passage into the coronal furrow appears only 1–2 mm. broad.

The peripheric corona of the umbrella ("corona umbralis") is half as broad as the radius of the central umbrella disk, and is composed of three different zones: an inner zone of tentacular pedalia (*ut*), a middle zone of rhopalar pedalia (*uo*), and an outer zone of marginal lobes (*l*). The inner zone consists of from 19 to 22 gelatinous sockels of the tentacles ("pedalia tentacularia," *ut*). They are thick, almost dice-shaped gelatinous pieces, which lie close together and are only separated by shallow radial furrows. The lateral length of this gelatinous die amounts to nearly 6 mm. Each pedalium forms the basis or socket of a tentacle, which springs from its outer surface. On closer consideration we perceive the following conditions of form:—The upper (aboral) surface (fig. 1, *ut*) is smooth, arched rather convexly and hexagonal; of the six side lines of this hexagon, the inner are contiguous to the coronal furrow, and lies opposite the radial furrow (*es*) between each two adjacent teeth of the central disk (*er*). The two inner lateral lines of the hexagon are contiguous to the corresponding lateral lines of the two adjacent, whilst of the three external lines, the middle touches the tentacle basis, and the two outer lateral lie opposite the two adjacent rhopalar pedalia (*uo*). The lower (oral) surface of the tentacular pedalia has the form of a parallel trapeze, and forms the upper wall of a tentacular pouch. Their inverted lateral surfaces are separated by a radial furrow, which corresponds to the middle line of the disk teeth, and of the rhopalar pedalia. Their axial surface forms the outer, almost perpendicular or only slightly overhanging wall of the coronal furrow, whilst their abaxial surface serves for the insertion of the proximal tentacle bulb.

The gelatinous sockels of the sense clubs ("pedalia rhopalaria") alternate regularly with the gelatinous sockels of the tentacles, and form the second middle zone of the umbrella corona (figs. 1, 4, *uo*). They are nearly as large as the tentacular pedalia, somewhat longer but not so thick, and are inserted with their proximal part between the distal sides of the latter. Their upper aboral surface is almost pentagonal, and depressed (fig. 1, *uo*). Their lateral margins are separated by a broad interspace which is filled by the bulb of the tentacle. Its truncated distal margin bears a pair of thin marginal lobes and the rudiment of a sense club in the incision between the pair.

The marginal lobes ("lobi marginales," fig. 4, *l*) form the third or outer zone of the umbrella corona. They amount in number from 38 to 44, as each marginal lobe is inserted between a tentacle and a rhopalium. Their shape is a longish round, 2–3 mm. broad, 5–6 mm. long. The proximal third of each marginal lobe consists of a thick semi-oval gelatinous part, which is merely the distal bifurcation of a rhopalar pedalium. The middle and distal third of the marginal lobe is formed by a very thin membranous, folded marginal border ("patagium," *lp*). This was invariably torn and badly preserved.

The gelatinous disk (*ug*) of *Atolla* is thick and firm (fig. 4, left half, in vertical meridian sections). It has the consistency of a tolerably firm fibrous cartilage. In the central umbrella disk (*uc*) its thickness amounts to 5 mm., even to 10 mm. at the thickest part at the marginal teeth (*er*); whilst immediately outside these, at the thinnest part of the coronal furrow (*ec'*), it is only ½ mm. The gelatinous substance of the pedalia is from 4–7 mm. thick.

The umbrella margin of *Atolla* includes all the parts lying outside the coronal muscle, and is therefore composed of from nineteen to twenty-two tentacles, the same number of sense clubs alternating with them and twice the number of marginal lobes, inserted between the former and the latter. The rhopalia at the distal margin of the rhopalar pedalia are, however, so small and the two marginal lobes at the distal end of the pedalia, which enclose the rhopalia, are so closely united, that at a superficial glance it looks as if the umbrella margin was merely composed of alternate tentacles and rhopalar pedalia. Closer investigation and comparison with the more completely developed umbrella margin of the closely allied *Collapsis* (System, pl. xxvii.) shows, that the umbrella margin is essentially composed like that of the latter, only that the sense clubs and their pouches have undergone much greater retrograde formation in *Atolla*.

The tentacles (figs. 1–4, *t*) are very weak, hardly half as long as the radius of the umbrella, they are shaped like an awl and finely pointed towards the thin end.

Their basal part is strongly thickened and forms a conical tentacle bulb, which fills the interspace between each two rhopalar pedalia, and is inserted with a broader base at the distal side of the tentacular pedalium. This basal part is also hollow and contains the cæcal end of the thin tentacular canal, whilst the distal part of the tentacles is solid (as in *Nauphanta*). A strong longitudinal muscle runs both on the upper and the lower surface of the tentacle. The upper or external, abaxial tentacle muscle (fig. 4, *mt'*) is the shorter and weaker, only occupies the proximal third of the tentacle, and passes to the outer margin of the upper surface of the tentacular pedalium. The lower or internal axial tentacle muscle (fig. 4, *mt''*) is longer and stronger, runs along the whole length of the tentacle, and passes with two very strong, fusiform radial muscles (*mk*, fig. 3, above, to the right) to the umbral surface of the tentacular coronal pouch (as in *Periphylla*, Pl. XXII.).

The sense clubs (" rhopalia," *or*) in *Atolla* are quite rudimentary and more slightly developed than in any other Discomedusæ hitherto examined, in fact this might be easily overlooked, as their obscure rudiments lie hidden at the distal margin of the rhopalar pedalia, between the basis of the two marginal lobes of a pair. It was only with considerable trouble that I succeeded in determining their existence; they alternate regularly with the tentacles, so that their number also amounts from nineteen to twenty-two. Their anatomic nature could unfortunately not be found out on account of their small size and the bad preservation of the umbrella margin in all five specimens; but as the sense clubs are indubitably in the same position and better developed in the closely allied *Collapsis* (System, pl. xxviii. figs. 3, 4), there can be no doubt as to the significance of the small rudiments in *Atolla*. We have probably to do here, as in many other deep-sea animals, with a phylogenetic retrograde formation of this organ of sense.

The subumbrella (figs. 2, 3, 4) is divided in the same way as the exumbrella, by the deeply incised coronal furrow, into two separate principal areæ, which are only connected by the thin gelatinous ring (*ec*) at the bottom of the coronal furrow. The central area of the subumbrella is therefore the same size as the central disk of the umbrella; it is formed by the gastrogenital membrane, which reaches as far as the distal margin of the coronal sinus, and contains the stomach in its central part and the corona of eight genitalia (*s*) and their alternating deltoid muscles (*md*) in the peripheric part. The deltoid muscles are narrow and slightly developed, especially the four perradial (*md'*) whilst the four interradial appear to be considerably broader (*md''*). All the eight deltoid muscles in *Atolla* are triangular only in the distal half, and rectangular in the proximal half (between the genitalia); the interradial muscles are inserted on the base line of the cathammal areæ (*kt*), the perradial at the distal margin of the gastral openings (*go*).

The coronal area of the subumbrella begins at the distal margin of the genitalia, and is separated from central area by the very thin ring of the gelatinous disk, which forms the bottom of the deep coronal furrow. The coronal area of the subumbrella in *Atolla* consequently corresponds exactly to the umbrella corona of the exumbrella, and is likewise divided into three zones: the inner zone of the internal coronal muscle, the middle zone of the external coronal muscle, and the outer zone of the marginal lobes. The broad, strongly-developed coronal muscle ("musculus coronaris") consists in *Atolla*, as in *Collapsis* (System, taf. xxviii.), of two separate sharply-defined halves. The inner coronal muscle ("musculus coronaris internus," *mc*) is ·5 mm. broad, thin and delicate, and extends like a veil over the inner zone of the coronal area of the subumbrella. It leaves the proximal third of this zone free, as it does not extend as far as the coronal furrow; it forms at the same time the proximal third of the coronal pouches, which occupy the greater part of this zone. The outer coronal muscle ("musculus coronaris externus," *mc''*) is only 4 mm. broad but extremely thick; like the outer muscle it consists entirely of circular muscular fibres; these are accumulated in many layers one above the other in such a way that they represent a band-shaped circular muscle, 2 mm. thick. This extremely strong fleshy mass belongs to the most powerful muscular formations hitherto observed in the Medusæ (comp. the transverse section, fig. 4, left, *mc''*, and figs. 7, 8, *mc''*). The 19 to 22 deep radial furrows of the subumbral under surface, which correspond to the tentacles, divide the outer coronal muscle into the same number of sections (figs. 2, 3). Whilst the sharply-defined external coronal muscle forms the middle zone of the coronal area of the subumbrella, its external zone occupies the corona of marginal lobes; at the subumbral side of each lobe we find a weaker longitudinal muscle, which radiates into the thin membranous and folded marginal border, the patagium.

The umbrella cavity in *Atolla* is very small, corresponding with the flatness of the disk. As the wide œsophagus reaches to its opening and fills its axial space, the umbrella cavity actually merely consists of the narrow, circular, hollow space, between the external wall of the œsophagus and the corona of genitalia. Between the four perradial mesenteric folds of the stomach (*wr*) it is depressed in the form of four conical niches projecting inwards, which may be considered interradial funnel cavities, although only of small extent and depth (figs. 1, 3, *ii*).

The gastrovascular system (figs. 3–6) of *Atolla* is closely allied in many and important respects to that of the foregoing *Nauphanta*, but still shows several peculiarities which remind us partly of the Tesseroniæ (Peromedusæ), partly of the Semostomæ. Of the two principal sections, the axial principal intestine is very simply formed, in the shape of a quadrangular, depending œsophagus, whilst the peripheric coronal intestine shows very complicated formations, and extends in the form of a horizontal corona of pouches, communicating with the axial intestine by four perradial gastral openings.

The central principal intestine ("gaster principalis," figs. 3–6, *g*) forms a short, wide quadrangular œsophagus, which hangs freely from the central part of the umbrella disk, and fills the greater part of the umbrella cavity, its oral margin (*am*) reaches to the opening of the latter. Its typical form is a regular quadrangle prism, whose lower surface occupies the simple quadrate oral opening, whilst the upper surface is formed by the endodermal surface of the central gelatinous umbrella. Both these two surfaces and each horizontal transverse section of the œsophagus describe a regular cross, as four perradial cross limbs project centrifugally the whole length, whilst the four interradial oral columns (*ac*) project inwards centripetally. The largest horizontal diameter of the gastral hollow space (in the perradia) amounts, both at the base of the stomach and at the oral opening, to from 22–34 mm., whilst the smallest diameter (in the interradia) amounts to only half as much, 11–12 mm. The entire height or length of the œsophagus is still less, amounting from the base to oral margin, only from 8–10 mm.

The gelatinous fulcral plate (*zw*) is strongly thickened in the upper half of the subumbral gastral wall, and forms several depressed elevations (fig. 5, *gw*) on its inner surface. It is very delicate and thin, however, in the lower oral half. The circular muscular layer of the œsophagus is also only slightly developed. As in *Nauphanta* (Pl. XXVIII. fig. 14), there is a circular constriction in the middle of its length, which divides the œsophagus into two chambers, shaped like truncated pyramids, which are connected by their narrow bases. We may, perhaps, compare this circular stricture, as in *Nauphanta*, with the palatine door of the Tesseroniæ, in which case the lower chamber (which widens below, towards the mouth) must be regarded as the buccal stomach or œsophagus, and the upper chamber (which widens above, towards the bottom of the stomach) as the central stomach fused with the basal stomach. In transverse section, through the circular stricture or palatine opening (fig. 6), the largest (perradial) diameter of its cruciform lumen only measures 15 mm., the smallest (interradial) only 6 mm. Below the circular stricture the thin perradial walls of the buccal stomach project, inflated to the outside, and form buccal pouches (fig. 3, *bb*) which are separated by interradial buccal columns projecting inwards (*wc*), as in *Periphylla* (Pls. XVIII.–XX.), but not so strongly developed. Above the palatine opening, the central stomach arches outwards perradially in the same way, corresponding to the characteristic crossform of the gastral covering.

The covering of the stomach, or that part of the endodermal surface of the central gelatinous umbrella, which forms the upper (aboral) wall of the quadrangularly prismatic œsophagus, shows, when the latter is removed, the distinct crossform shown in fig. 6 and the centre of fig. 3. The four perradial limbs of the regular cross are rounded off, almost circularly, and are separated by the four triangular septa, projecting inwards, which on account of their special importance, we shall immediately describe more minutely as "cathammal plates" (*kt*). In the middle, between the cathammal plates, four broad tangential transverse clefts remain at the distal end of the four cross-limbs; these are the four perradial gastral openings (figs. 3, 6, *go*) through which the central stomach opens into the peripheric coronal intestine.

The septal plates ("tabulæ cathammales," figs. 3, 6, *kt*), are equilaterally triangular plates, in which the umbral and the subumbral wall of the umbrella are firmly fused together, and which subsequently, as interradial septa, separate the four perradial cross pouches of the bottom of the stomach and their peripheric openings, the gastral openings (*go*); they therefore correspond completely to the four small septal nodes of *Nauphanta* or of the Peromedusæ (*kn*), and also to the four long, narrow cathammal ridges of *Lucernaria* and of the Cubomedusæ (comp. above). They are at the same time homologous with the gastral tæniola of *Scyphostoma*, as all such septal or cathammal formations have arisen from fusions of the umbral and subumbral parts of these tæniola. In most Discomedusæ (Semostoma and Rhizostoma) the four primary cathamma have entirely disappeared, and the gastral filaments are consequently placed on the subumbral gastral wall. In *Atolla* the septa are distinguished by their broad flat form; each cathammal plate bears a two-limbed phacellus (as in *Periphema*) and forms an equilateral triangle, whose point is directed centripetally towards the centre of the stomach, whilst the two limbs, concavely bent inwards, are beset with a row of short, closely compacted gastral filaments (figs. 3, 5, *f*). The abaxial (tangential) base of the triangle measures 12 mm., its (interradial) verticle line 6 mm. The limbs of each two adjacent triangles pass externally into one another in a semicircular arch, which is only interrupted in the middle by the perradial gastral opening (*go*). A red-brown arched line, into which numerous radial, rust-red lines covering the surface of the equilateral triangle open, runs towards the exterior, a millimetre apart from, and parallel to, the concave limbs of the triangle (or the line of insertion of the gastral filaments, *f*). These fine rust-red lines are sinuated, tube-shaped glands, which open into the gastral cavity at the rust-red concave line of the limbs, and which we may regard as central liver glands. They have the same formation as the rust-red, peripheric adocular canals, which we shall presently recognise in the rudiments of rhopalar coronal pouches, which have undergone retrograde formation. The narrow hollow space of the simple tubes is lined by a layer of red-brown, irregularly polyhedrical, glandular cells. Masses of yellowish and red-brown pigment granules and fat granules lie round the clear spheroidal nucleus, filling the whole protoplasm.

The gastral filaments (*f*) are placed, compacted in a row, on the two limbs of the triangular septal plates, which may, therefore, be regarded as flattened tæniola. If we suppose these tæniola separated from the umbrella cavity by hollows formed of four interradial conical subumbral funnels, we have the same condition as in *Periphema* (Pl. XXIV. fig. 1). The four centripetal points of the tæniola, from which the four pair of phacelli run out so that the two rows of filaments of each pair diverge simultaneously to the outside and to below, comport themselves in essentially the same way in both species. They are, however, much less strongly developed in *Atolla*; only from fifteen to twenty filaments are placed in a row on each limb of the phacelli, so that their aggregate number only amounts to from 120–160. The filaments are otherwise strong, full of glands, and often tongue-shaped or swollen like a club at their free end, 2–3 mm. long, 10–14 mm. thick.

The gastral openings (figs. 3, 6, *go*) are four horizontal transverse fissures, 4 mm. in breadth, which lie at the distal end of the four cross limbs of the bottom of the stomach and lead from it into the coronal sinus (*cs*). The upper lip, or the upper (umbral) margin ofthe transverse fissure, is somewhat concave and formed by a slightly projecting ridge of the endodermal wall of the gelatinous umbrella. The lower lip, or the lower (subumbral) margin of the gastral opening, on the other hand, is slightly convex, and formed by a thickened crescentic ridge of the subumbrella (at the proximal margin of the coronal sinus (figs. 3, 6, *go*). This lower lip can fall like a valve over the other and so shut off the coronal sinus from the œsophagus; it corresponds to the perradial pouch lobes of the Cubomedusæ. The two lateral oral angles of the gastral openings are bounded by the darkly-pigmented ridges of insertion or roots of the genital fulcra ("sterigmata," *st*, fig. 3).

The peripheric coronal intestine of *Atolla*, which only communicates with the central principal intestine by the four narrow perradial gastral openings, resembles that of *Nausithoë* and *Nauphanta* on the one hand, and that of *Periphylla* and *Periphema* on the other. It is divided into two sections, the proximal coronal sinus and the distal corona of pouches, by a subumbral circular furrow, corresponding exactly to the exumbral coronal furrow (*ec*), and is only separated from it by the thinnest part of the gelatinous umbrella (*ec*). The large coronal sinus ("sinus coronaris," fig. 3, *ec*) corresponds to the narrower sinus of *Nauphanta* (Pl. XXVIII. fig. 14, *cs*) and the broader sinus of *Periphylla* (Pls. XX.–XXII., *cs*). Whilst, however, in both these species it stands vertically (with an upper and lower margin and an inner and outer surface), in *Atolla* it has assumed a horizontal position (with an inner and outer margin and an upper and lower surface), corresponding to the strong depression of the discoid umbrella. It forms here a circular hollow space, 6–7 mm. broad and 1–2 mm. high. The upper or umbral wall of the coronal sinus forms the flat endodermal surface of the corona of teeth of the central gelatinous disk; it also shows externally a fine coronal furrow, from which numerous fine radial indentations project centripetally inwards (fig. 3, *zw*). The lower or subumbral wall forms the genital zone of the subumbrella, which is composed of the eight broad adradial genitalia and the eight narrow deltoid muscles alternating with them, four smaller perradial (*md′*) and four broader interradial (*md″*). The inner or axial margin of the coronal sinus is formed by the four perradial gastral openings (through which it communicates with the central stomach) and by the four abaxial base-lines of four interradial septal plates (*kt*) alternating with these. The external or abaxial margin is composed of the tangential transverse fissures by which the pouches of the corona of pouches open into the coronal sinus.

The marginal corona of pouches, the second principal section of the peripheric coronal intestine in *Atolla,* presents at first sight very peculiar conditions of formation, varying considerably from those of all other Cannostomæ. From the distal margin of the coronal sinus (*cs*) nineteen to twenty-two broad, oval, coronal pouches run out, which pass into the tentacles (fig. 3, to the left, below, *bt*). Their distal half is cleft into three narrow branches, of which the middle one (*ct*) enters a tentacle as tentacular canal, whilst the two lateral enter the inverted margins of the two adjacent rhopalar pedalia (*ck*). Between each two coronal pouches, however, a group of three narrow, cæcal, radial canals, which lie on the subumbral side of the rhopalar pedalia, run out from the coronal sinus. The middle one of these cæcal canals is longer and runs as rhopalar canal (*co*) directly to the rudiment of the sense club (*or*), whilst the two lateral, shorter adocular canals (*cx*) already end before reaching the distal margin of the coronal muscle; they are coloured rust-red, and show the properties as the glandular canals of the septal plates already described. If we compare this peculiar condition with that of the closely allied genera *Nauphanta* (Pls. XXVII., XXVIII.) and *Collapsis* (System, taf. xxix.), we see that the last-named group of narrow parallel cæcal canals represent a rhopalar pouch, which has undergone retrograde formation, and is cleft up to its original base into three canals; the middle one of these (*co*) corresponds to a distal rhopalar pouch, whilst the two lateral (*cx*) rudimentary "rhopalar lobe pouches" are transformed into glandular canals. These never enter the true marginal lobes, but are limited to their common basal part, the rhopalar pedalium. The tentacular coronal pouches (*bt*), which vary much less from the usual conditions and send out their two side branches into the marginal lobes, remain separated from the rhopalar pouches by a broad fused lobe clasp (*kl*), which projects centripetally to the distal margin of the coronal sinus. This peculiar modification of the marginal corona of pouches is probably in corelation with the retrograde formation of the sense clubs.

Genitalia (figs. 2–4, *g*). All the five specimens of *Atolla wyvillii* examined were mature females, three of whom had almost completely emptied out their ova. The ovaries (*s*) form eight adradial, broad, flat, elliptical pouches, lying inside the subumbral wall of the coronal sinus, and alternating with its deltoid muscles. They are not, however, regularly distributed as in the closely allied *Collapsis* (System, taf. xxviii. figs. 1, 6). But as the four stronger interradial deltoid muscles (*md''*) are considerably broader than the four weaker perradial (*md'*), the two genitalia originally belonging to one interradial pair lie further from each other, whilst the two reproductive glands almost touching each other, which lie on the two sides of a perradial deltoid mass, belong to two different pairs. The eight ovaries appear to be flattened, elliptical pouches, which lie freely on the outer, ectodermal, subumbral wall of the coronal sinus, and project freely as its pouched-shaped evaginations into the umbrella cavity (fig. 2). Closer examination shows, however, that they are rather enclosed in the hollow space of the coronal sinus, and that they lie on its inner endodermal subumbral wall (fig. 9, *w*); each genitalium is connected continuously with the wall, only at a single, limited spot, which we shall call the root of the genitalia ("sterigma," fig. 3, *st*; fig. 9, *st*, in radial section) as in *Nauphanta*.

Finer anatomy, moreover, shows an extremely complicated structure of the ovarian pouches, instead of the apparently simple conditions. The very thin subumbral wall of the coronal sinus (*cs*) only stretches superficially, like a delicate folded veil, freely over the lower surface of the genitalia (fig. 3, right half). The structure of the ovaries is most nearly allied to that of *Nausithoë* and *Nauphanta*, but is also closely connected with that of the Peromedusæ (*Periphylla* and *Periphema*); it shows, moreover, peculiar complications, which are difficult to understand, and do not occur in other Discomedusæ. We can distinguish two principal component parts in each ovary, the gelatinous fulcral frame or sterigma, and the endodermal germinal epithelium, which covers the sterigma, and produces the ova; the former is a process of the gelatinous supporting plate of the subumbrella of the coronal sinus, the latter is a local production of the endodermal epithelium of the supporting plate.

The "sterigma" (*st*) or the cartilage-like fulcral frame of the ovary gives the latter its characteristic form and corresponds to the "costa genitalis" of the Peromedusæ, to the "sexual axial plate" of the Cubomedusæ, and to the "genital fold" of many Discomedusæ. It consists of a strong scutiform gelatinous plate, hard as cartilage, and shaped like a kidney It is from 10–12 mm. long (in tangential direction), 6–7 mm. broad (in radial direction), and 1–2 mm. thick (in vertical direction). Like the scutiform sterigma of *Nauphanta* (Pls. XXVII., XXVIII. figs. 4–15), the sterigma of *Atolla* hangs freely, for the most part, in the hollow space of the coronal intestine (and here, therefore, of the coronal sinus), and is only connected with its subumbral wall at a single point. This spot, the root of the sterigma (*st*), is a narrow ridge, pigmented brown, from 5–6 mm. long and $\frac{1}{2}$–$\frac{3}{4}$ mm. broad (fig. 3 above to the left, *st*). It nearly fills the interspace between the proximal end of a perradial deltoid muscle and that of an interradial deltoid muscle, and forms part of the distal base-line of a distal cathammal plate (*kt*), whilst the middle third of this base-line serves as the base of insertion of an interradial deltoid muscle (*md''*), and therefore presents a complete homology with the septal nodes of the Peromedusæ, whilst its two lateral thirds are occupied by the sterigma roots of two ovaries which belong together. Like the whole equilaterally-triangular cathammal plate (*kt*), its base consists of a concrescence of the umbral and subumbral wall of the umbrella, immediately below which the cartilage-like gelatinous ridge, which forms the root of the sterigma, rises and then extends scutiformly. In *Atolla* as in *Nauphanta*, this fulcral shield projects, strongly arched into the hollow space of the coronal sinus and turns over at its convex distal margin (where it nearly touches the corona of pouches) in such a way as to originate a nearly closed genital sinus (fig. 9, *ss*). This sinus, therefore, assumes the form of a flat, nearly closed pouch, whilst the inverted ventral fold of the fulcral shield extends axialwards as far as the root of the sterigma with which it is fused in great part. At one single small spot only there remains a narrow opening, which leads from the hollow space of the coronal sinus (*cs*) into the genital sinus (*ss*). This narrow opening, the "apertura sinus genitalis" (fig. 3, left, *sa*) lies at the point where the sterigma root (*st*) touches the proximal margin of insertion of the interradial deltoid muscle (*md''*). The two sinus apertures of the two connected genitalia (of a pair) therefore lie near each other, and are only separated by the insertion of the interradial deltoid muscle (*md''*). The ova are developed from the germinal epithelium in the hollow of the sinus on the concave side of the shield and essentially in the same way as in *Nauphanta* and the other Cannostomæ. The Mediterranean *Nausithoë*, which has never been sufficiently minutely investigated either in this respect or many others, shows no essential difference on this point.

The germinal epithelium of the endoderm, from which the ova in *Atolla* are developed, lies exclusively outside the genital sinus, on the concave inner side of the pouch-shaped folded sterigma, whose convex outer side is only covered by the usual sterile endoderm of the subumbral wall of the coronal sinus. The youngest ova lie inside the genital sinus, on its proximal margin, the oldest ova on the distal margin, both on its dorsal and its ventral wall. We consequently find a double fertile germinal zone, which lies tangentially near the root of the sterigma, and forms a transverse ridge standing perpendicularly on the adradius. The youngest tangential rows of ova, which are followed to the outside distal walls (both on the dorsal and the ventral wall of the fulcral shield) by rows of older ova, lie on both sides of this neutral germinal zone. The oldest and ripest ova lie on the radial margin (radial section, fig. 9, *so*). The younger ova (on the proximal margin) are completely embedded in the gelatinous plate of the sterigma, and therefore lie in closed fulcral capsules, as in *Periphema* (Pl. XXV. fig. 7). This is equally the case in the closely allied *Nausithoë* and *Nauphanta* (Pl. XXVIII. fig. 15). The ripe ova of *Atolla* are very large and spheroidal, they are more than a millimetre in diameter, and contain a visible food-yolk. When completely ripe they fall into the genital sinus (*ss*), from which they are emptied through the narrow aperture (*sa*) into the coronal sinus (*cs*) and thence pass outside through the stomach and mouth. The ovaries both of *Atolla* and of *Nauphanta* were, unfortunately, badly preserved, the epithelium being almost entirely destroyed, so that the finer structure could not be satisfactorily investigated. The peculiar finer structure and development of these very old Cannostomæ appears, however, to present an essential homology with those of the Peromedusæ. In both the former (Ephyridæ and Linergidæ) and the latter (Pericolpidæ and Periphyllidæ) the remarkable and complicated conditions of the genitalia merit more minute investigation of well-preserved material.

SECOND SUB-ORDER OF DISCOMEDUSÆ, SEMOSTOMÆ, L. Agassiz, 1862.

Flag-mouthed Discomedusæ. Discomedusæ with four large, perradial, folded oral arms, with simple, central oral opening, and with long hollow tentacles.

Family, CYANEIDÆ, L. Agassiz, 1862.

CYANEIDÆ, Hæckel, System der Medusen, 1879, p. 518, taf. xxx.

Semostomæ with broad radial pouches, and branched, cæcal lobe canals, without coronal canal. Discomedusæ with simple, cruciform, central oral opening, surrounded by four perradial, folded oral arms. Stomach with sixteen or thirty-two broad radial pouches, whose distal margin is cleft into thirty-two or sixty-four branched lobe pouches; the branches of the latter are cæcal, not anastomosed; no coronal canal. Genitalia, four waved bands or frills in the oral gastral wall, usually in the form of wide sacs, hanging freely and without sub-genital cavities. Sixteen to thirty-two or more marginal lobes; eight or sixteen sense clubs (four perradial and four interradial, with sometimes also eight adradial). Tentacles long and hollow, eight or more in number.

Sub-family, DRYMONEMIDÆ, Hæckel, 1879.

Cyaneidæ with eight sense clubs (four perradial and four interradial), which lie distant from the umbrella margin in deep niches of the subumbrella; also with numerous tentacles, which are scattered almost over the whole subumbrella, but are wanting in the marginal lobe zone.

Drymonema, Hæckel, 1879.[1]

Cyaneida with 8 sense clubs, lying far from the umbrella margin, in deep niches of the subumbrella. Tentacles very numerous, irregular, scattered almost over the whole surface of the subumbrella and inserted in deep radial furrows, between numerous strongly dendritically branched subumbral radial ribs. Sixteen broad, radial canals; these are very short, their thirty-two lobe pouches, and the dichotomous canal branches of the latter, proportionately more strongly developed.

The genus *Drymonema* is as yet only known from the Mediterranean deep-sea species described below, and is so strikingly distinguished by many peculiarities from the other Cyaneidæ, that it represents a special sub-family of them, the Drymonemidæ. Whilst in all other Cyaneidæ the peripheric tentacle zone remains separated from the periphéric margin of the central stomach by a broad coronal muscle, which is usually laid in many circular folds, in *Drymonema* both this coronal muscle, and the sixteen broad radial pouches in whose subumbral wall it lies, have undergone such strong retrograde formation that we can only discover faint rudiments of them. On the other hand, the peripheric part of the umbrella corona, with the zone of tentacles and the branched lobe pouches, attains a most extraordinary degree of development. The marginal lobes themselves are fused together, and form a broad marginal border (in some measure a velarium), which is separated from the broad marginal zone, by a deep marginal coronal furrow. The latter occupies nearly the half of the whole subumbrella, and is beset over its whole extent with numerous scattered tentacles. The tentacles are inserted by their basal part in deep radial furrows of the subumbrella, which are separated by its strongly projecting dichotomously branched ribs. The eight sense clubs lie in deep niches of the subumbrella, at the marginal coronal furrow, far from the free umbrella margin, However peculiar these conditions of formation of the subumbrella, and the corresponding modifications of the peripheric vascular system in *Drymonema* may appear, they are really easily derived from the well known conditions of the *Cyanea;* we only require to suppose the eight adradial horseshoe-shaped tentacle areæ, in which the tentacles of the *Cyanea* are inserted in several rows, the one behind the other, so widely extended that the broad coronal muscle at their proximal margin is reduced to a narrow edging. The sixteen broad radial pouches lying below the coronal muscle become likewise rudimentary, and the numerous tentacles are scattered singly on the wide subumbral surface. On the other hand, the broad marginal lobe zone, whose marginal lobes are fused into a connected velarium, remains free from them. The eight rhophalia, which originally lay freely on the umbrella margin between the sixteen Ephyra lobes, are consequently now placed entirely on the lower surface of the umbrella.

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[1] Δφυμός = a wood; νῆμα = threads.

Drymonema victoria, Hæckel (Pls. XXX., XXXI.).

Drymonema dalmatina, Hæckel, 1879, System der Medusen, p. 642, No. 606.

Umbrella shallow, discoid, four to five times as broad as high. Marginal umbrella border (velarium) very broad, slightly indented, with eight to ten deep exumbral radial furrows, between which eight to ten double lobes of the gelatinous umbrella appear in each octant (between each two sense clubs). Eight sense clubs in the subumbral velar furrow, in deep niches of the subumbrella, at a distance of nearly one-third of the radius of the umbrella, from the umbrella margin. Four perradial oral arms and four interadial curtain-shaped, delicate-membraned, depending reproductive pouches, the former nearly as long as the radius of the umbrella, the latter half as long. Tentacles very long and very numerous (500–600), scattered all over the subumbrella (inside the velar furrow) and inserted in deep radial furrows between strong, straight, dichotomously branched radial ribs of the subumbrella. Only the marginal velar zone and the central area of the peristom remain free from tentacles. Horizontal diameter of the umbrella, 120–160 mm.; vertical diameter, 30–40 mm.

Habitat.—The Mediterranean. The following description and figure are taken from four large, well-preserved spirit specimens which I owe to the kindness of my friend, Gregor Buccich at Lesina, and which he found on the coast of Dalmatia, near the island of Lesina. A small fragment of a Medusa which I found in a bottle of the Challenger collection appeared to be identical with these. This bottle (which also contained the fragment of a *Pectanthes asteroides*, p. 20) was marked Station 4, entrance to the Straits of Gibraltar. Lat. 36° 25′ N., long. 139° 28′ E. Depth, 600 fathoms. 16th January 1873. Further research must prove whether this remarkable Cyaneid (as yet the first and only Cyaneid of the Mediterranean) be really a deep-sea Medusa or not.

The umbrella (Pl. XXX. fig. 1, Pl. XXXI. fig. 8) forms a flat disk 12–16 cm. in diameter and 3–4 cm. in height. The exumbrella is smooth, depressed on the whole, and is divided by a shallow marginal coronal furrow into a thick central umbrella disk and a thin peripheric corona of lobes (velarium). The radius of the former measures 55 mm., that of the latter 25 mm. In the smooth upper surface of the central umbrella disk, which is only slightly vaulted on the whole, we can distinguish sixteen dark radial streaks which are simple in the inner third but cleft into two diverging limbs in the middle third so as to form the same characteristic star figure as in *Chrysaora* (System, taf. xxxi.). The peripheric corona of lobes (or velarium) which is more strongly vaulted outwards, shows sixty-four deeper radial furrows, of which the one half appears as processes of the thirty-two disk streaks, whilst the other half are placed between the streaks. Besides these there are several (usually three) finer furrows visible between every second of these sixty-four deep radial furrows in the exumbrella of the umbrella corona, so that it appears thickly ribbed over its whole outer surface (fig. 8). The gelatinous substance of the umbrella appears thick and firm, almost like cartilage. It is as much as a centimetre in thickness in the central umbrella disk, decreases suddenly at the coronal furrow, so that it is only one to two millimetres thick at the soft and very mobile umbrella margin.

The umbrella margin appears at first sight to be perfectly circular and only slightly indented; closer examination, however, shows that the whole umbrella corona (25 mm. broad) is really composed of eighty long, narrow, marginal lobes, fused together by their edges, whose distal edges project a little at the umbrella margin as slight curves, separated by shallow indentations (as in many Rhizostoma). Sixteen of these eighty fused coronal lobes run out in pairs from the eight rhopalia, and may be regarded as eight pairs of fused ocular lobes; the other sixty-four were originally tentacular lobes, and may also be termed velar lobes, as they have no longer any relation to the tentacles. Eight velar lobes between two ocular lobes, or actually eight velar double lobes, as they appear divided in two by a fine median furrow, therefore fall in each octant of the umbrella. These eighty coronal lobes constitute the very movable and flexible velarium, which extends to the velar coronal furrow, and was retroverted on the inner side of the umbrella in most of the spirit specimens examined. A marginal layer of the circular muscles is developed on its subumbral surface, so that it serves as an admirable swimming organ, as in many Rhizostomæ.

The lower umbrella surface (subumbrella, Pl. XXX. fig. 1) of this Medusa is marked by a very striking peculiarity, which at the first glance distinguishes it not only from all other Cyaneidæ but from all other Medusæ hitherto known. The subumbrella is divided by two deep coronal furrows, an inner peristom furrow and an outer marginal coronal furrow, into three separate zones, viz., an inner peristom area, a middle tentacle zone, and an outer lobe zone. The central peristom area of the subumbrella (fig. 9) contains the oral cross with its four perradial limbs, and the four powerful perradial oral curtains hanging from them, as well as the four interradial genitalia, alternating with the latter. The peristomal coronal furrow, which separates the peristom area from the tentacle zone, cuts deeper into the perradii than into the interradii.

The intermediary tentacle-zone of the subumbrella is bounded by the peristomal coronal furrow from the peristom area on its concave proximal margin, and by the subumbral velar furrow, from the peripheric lobe zone at its convex distal margin (fig. 1). Its whole extent is traversed by deep radial furrows, in such a manner that numerous thick radial swellings, branched dichotomously towards the periphery, are placed closely beside each other (quadrant, left, below in fig. 1). Numerous long tentacles are scattered everywhere between these radial ribs or swellings, whilst the peripheric lobe zone of the subumbrella, or the velarium of tentacles, and the central peristom area are entirely free from them. On closer examination we can distinguish on the whole forty such thick radial swellings of the subumbral tentacle zone; a stronger, perfectly straight, unbranched radial rib runs in the eight principal radia, direct to the eight sense clubs, whilst four bunched ribs, or broader, dichotomously branched radial swellings, run between each two such principal ribs from the centre to the peripheric coronal furrow. Of the eight principal ribs (of which two are shown in fig. 1, left below), the four interradial are about one-fourth longer than the four perradial, as the former project further inwards, between the limbs of the oral cross. The four principal ribs are almost linear, rather broader in the middle, quite straight, and unbranched, but divided by a fine traversing principal furrow into two parallel limbs lying close together, so that they really represent double ribs. The four bunched ribs, which occupy the entire space of an octant of the umbrella, between each two principal ribs, form narrow equilateral triangles, whose base line (or the broad distal margin at the velar furrow) is thrice as broad as the truncated point, or the narrower proximal margin, at the peristom furrow. The two medial bunched ribs, on the two sides of the adradial subumbral furrow, are as broad, but rather shorter than the two lateral bunched ribs which lie near the enclosing principal ribs. Each of the thirty-two bunched ribs of the subumbrella is dichotomised nearly three to four times, so that the number of its distal terminal branches (at the subumbral coronal furrow) amounts to from eight to twelve; all the bifurcate branches are extended straight, and only diverge slightly outwards at very sharp angles, so that the terminal branches lie, nearly parallel to each other, only separated by narrow radial furrows. The secondary and tertiary furrows between the bifurcate branches are much narrower and shallower than the deep, broad furrows between the separate bunched ribs (comp. the quadrant, left, below in fig. 1).

The tentacles are very numerous (nearly 500–600); they lie scattered over the whole extent of the subumbral tentacle zone and spring from its radial furrows, between its ribs. The tentacles appear, at first sight, scattered very irregularly over the whole extent of the broad tentacle zone; closer examination, however, shows that they are distributed quite regularly. In each octant, there is first an adradial tentacle, usually inserted proximalwards in the middle between every two principal ribs, at the proximal end of the adradial subumbral furrow; this is probably the original tentacle of the *Ephyra,* usually migrated inwards. Next follow two subradial tentacles, lying rather further outwards, in the distal end of the two subradial subumbral furrows, which lie exactly in the middle between the eight adradial and the eight principal furrows of the subumbrella. Outside these three strong, innermost tentacles of each octant of the umbrella, which separate its four bunch ribs, at the distal end, come four more tentacles in the angles of bifurcation of the ribs. The number of tentacles increases towards the outside, corresponding to the repeated bifurcation of the bunched ribs; they always spring at the angle of the bifurcation in the depth of the radial furrow, between each two bifurcate branches. On the whole, fifteen to twenty tentacles may come on each bunched rib, but their number cannot be fixed exactly, as they become smaller, and less distinct towards the peripheric coronal furrow, and at last only appear between the ribs, as unimportant vesicular evaginations of the radial pouches. If we draw concentric circular lines, through the insertions of the tentacles on the subumbrella, an innermost proximal circle will be formed by the eight adradial tentacles, a second circle by the sixteen subradial tentacles; then a third circle of thirty-two tentacles, which are placed in the first bifurcation of the thirty-two bunch ribs, and so on. The distribution becomes irregular towards the outside. The tentacles are quite cylindrical, often swollen like a club at the end, and seem to be of the same nature as in *Cyanea.* Their length and thickness appears very unequal. In the specimens before me, most of the tentacles are short (clearly torn away), the longest are longer than the diameter of the umbrella; the thickness in the thickest tentacles amounts to from 1–2 mm., sometimes to 3–4 mm.; but numerous smaller tentacles, thick as a thread, are placed between them.

The peripheric lobe zone of the subumbrella (or the velarium, which may be also termed "rhopalar zone") is 25 mm. broad, and therefore occupies nearly one-third of the radius of the umbrella. It is divided from the broad tentacle zone by the velar furrow (or the marginal coronal furrow) of the subumbrella, on which the eight sense clubs lie. As the firm gelatinous substance of the umbrella suddenly becomes very much thinned away at the velar furrow, the lobe zone is very flexible; it is more or less bent round, and in most of the specimens before me, turned back towards the tentacle zone of the subumbrella. Its subumbral surface is quite smooth, covered by a layer of circular muscular fibres, bears no tentacles, and is only traversed by very shallow, almost imperceptible, radial furrows, which correspond to the deeper radial furrows between the marginal lobes of the exumbrella. The eight rhopalia or sense clubs (fig. 1, below) lie in the subumbrella, at the proximal margin of the velar zone, immediately outside the velar coronal furrow.

The eight sense clubs (4 perradial and 4 interradial) are remarkable from their completely subumbral position; their distance from the umbrella margin amounts to nearly the half of their distance from the umbrella centre, therefore, to nearly one-third of the whole radius of the umbrella. The sense clubs lie entirely hidden in eight deep subumbral sense niches, at the distal end of the eight principal radial furrows. Each sense niche ("antrum rhopalare," fig. 2, *on*) is broadly lanceolate in shape and is enclosed by a pair of thick, narrow bean-shaped gelatinous swellings, like a pair of fleshy lips; these clearly correspond to the two sense folds of other Discomedusæ, or to the rolled-in medial inner margins, the original ephyra lobes of the umbrella margin; they are here thickened, and have their concave medial margins turned to each other in such a way that both their distal and their proximal ends touch, and the sense club only remains open between them below (fig. 2). Their upper covering (corresponding to the protective scale or protective covering of the other Discomedusæ) is formed by the gelatinous substance of the umbrella. The sense club lies almost in the middle of this deep lanceolate sense niche (rather nearer the proximal margin), and is fastened to the under side of its covering in such a way that its radial longitudinal axis appears directed from the inside and above, towards the outside and below, therefore towards the distal entrance of the niche. The rhopalia themselves are comparatively small, almost acorn-shaped, and were sufficiently well preserved in the spirit specimens before me to admit of closer examination with the aid of fine transverse and longitudinal sections (figs. 2–7). Their form and structure on the whole do not differ essentially from that of *Cyanea*. Each rhopalium consists of a thicker proximal and a thinner distal part; separated by a slight circular constriction; the base of insertion of the proximal part is also strongly constricted (fig. 5, longitudinal section). The sense canal (*co*), which is very much narrowed at this basal stricture, immediately becomes enlarged again and is not limited here to the proximal half (as is usual in the Discomedusæ), but also passes over into the distal half containing the otolite (fig. 6). The acoustic ectodermal epithelium of the sense club is single-layered, and consists of flagellate, cylindrical cells in the basal half, and of thin, flat cells in the distal half. The thin but firm supporting plate lying below the sense club is very much thinned away in the distal half. The endodermal epithelium is single-layered in the wide ampulla-like swollen basal half, but composed in the distal half of from four to five layers of cells, placed one above the other (figs. 6, 7, *ol'*). Each of these cells contains a small crystalline otolite (*ol*). As soon as we dissolve the calcareous otolite in a drop of acid, we see plainly the stratified otolite cells, as well as the cæcal distal end of the sense canals which leads with a double arching outwards as far as the middle of the distal half of the rhopalium containing the otolite (fig. 6, radial longitudinal section; fig. 7, oblique nearly horizontal section).

The gastrovascular system (Pl. XXX. fig. 1) of *Drymonema* is constructed essentially on the same hereditary family type as that of all other Cyaneidæ, but is distinguished individually from the rest in a very striking manner, corresponding to the peculiar transformation of the umbrella corona. The formation of the branched pouches of the peripheric coronal intestine in the latter is in especial very peculiar, whilst the conformation of the central principal intestine and its oral organs do not vary essentially from those of *Cyanea*.

The central principal intestine consists of a flat-discoid central stomach, having the oral cross with its appendages in the centre below, whilst its peripheric margin opens into the pouch corona of the coronal intestine. The sharp, peripheric margin of the central stomach shows sixteen projecting corners, corresponding to the sixteen radial pouches opening into it and the sixteen subradial septa or cathammal ridges by which these are separated from each other. The largest diameter of the margin amounts to from one-third to one-fourth that of the whole umbrella. Its upper aboral wall, or the roof of the stomach, is formed by the smooth endodermal surface of the thick firm cartilage-like central gelatinous disk; it is traversed by fine radial furrows, which run out from a central four-lobed coronal furrow and are dichotomised towards the periphery. The lower or oral wall of the discoid central stomach, or the bottom of the stomach, is formed by the thinner but equally firm, cartilage-like peristom disk. The central oral cross (figs. 1, 9), whose four perradial limbs pass into the deep oral grooves on the axial surface of the oral curtains, opens into the middle of the peristom disk. The wall of the cruciform oral opening forms a very firm, thick cartilaginous oral ring, as in *Cyanea*. The latter passes at the four perradial limbs of the oral cross below into the cartilaginous abaxial wall of the arm grooves on the one hand, and outward into the four strong cartilaginous oral pillars on the other. These pillars divide the peristom area into four interradial areæ, which are occupied by the delicate, thin-membraned gastrogenital membrane (*gg*), and from which the four genitalia hang down as four wide, folded cæcal pouches (fig. 9, *s*).

The oral curtains, or arm curtains, comport themselves on the whole the same as in *Cyanea* and *Desmonema* (System, p. 522, taf. xxx. fig. 1–3). They form four powerful, very broad, thin-walled membranes of a roundish triangular outline, whose proximal root proceeds from the four perradial oral pillars. At the root, the thickened, hardened gelatinous lamella of each curtain still forms a very firm, stiff, cartilage-like plate, equilaterally triangular in outline, which represents, in a measure, the peripheric extension of the perradial oral pillar and contains a deep groove on its axial surface, the arm groove or the direct process of a limb of the oral cross. At the distal margin of this triangular cartilaginous plate of the arm root (at the base line of the equilateral triangle) however, the thick cartilaginous mass of the subumbral gelatinous plate suddenly passes into a very thin, delicate, fulcral lamella. This is spread out widely in the form of the powerful arm curtain (*aq*), which lies in numerous longitudinal folds, like a curtain full of folds, and represents an extremely delicate transparent membrane, whose axial surface is covered by endoderm, and the abaxial surface by ectoderm. The two plates of epithelium touch one another at the curled distal margin of the arm curtains. This margin nearly coincides at the flatly extended curtains with the umbrella margin, so that they can also envelop the whole subumbrella from beneath like a veil. The total length of the oral arms is therefore nearly equal to the radius of the umbrella.

The peripheric coronal intestine, which opens with sixteen broad fissures into the peripheric margin of the central stomach in *Drymonema*, is distinguished strikingly from that of other Cyaneidæ by this peculiarity, that the sixteen broad radial pouches of its inner zone are shortened extremely, and appear almost rudimentary, whilst their peripheric ramifications, which correspond to the lobe canals of the other Cyaneidæ with their branch canals, are of extraordinary extent; they here occupy from two-thirds to three-fourths of the whole umbrella, as the radial septa or cathammal ridges advance centripetally between them, nearly to the periphery of the central stomach (comp. fig. 1, quadrant, to the right above).

The sixteen broad radial pouches, which run out from the periphery of the central stomach, are extremely short and hardly recognisable as independent formations, as they immediately become dichotomised. A stright ocular canal (figs. 3, 4, *co*) runs from the eight narrower ocular pouches to the eight sense clubs, whilst a pair of narrow ocular lobe pouches run parallel to the two sides of the canal, and dichotomise towards the periphery (fig. 4, *cl*). The eight adradial tentacular pouches, which alternate with the eight ocular pouches, are much broader, and immediately divided by repeated bifurcations into numerous peripheric branch canals. Whilst these branch canals, or the branched marginal vessels which originally run out from the distal margin of the lobe canals, are usually distinguished in the other Cyaneidæ by their arched course and delicate dendritic side branches, in *Drymonema* they run in a perfectly straight line and almost parallel, close to each other, only diverging radially a little towards the umbrella margin. Corresponding to this straight course of the narrower, rectilinear branch canals, we have the simple ridge form of the rectilinear radial septa or fused ridges by which they are separated. The eighty narrow, long, marginal pouches, which correspond to the lobes of the broad, rhopalar, marginal selvage, are likewise without dendritic side branches. Anastomosed formation between adjacent branch canals never takes place, and there is no trace of a coronal canal (fig. 1, quadrant to the right above).

The genitalia or reproductive glands (Pl. XXXI. figs. 9–11) comport themselves the same as in *Cyanea* and *Desmonema*. They form four long band-shaped frills, which are fastened to the endodermal inner wall of four powerful, many-folded, gastrogenital pouches. The latter are four interradial cæcal sacs of the central stomach, which project as evaginations of the bottom of the stomach between the four perradial oral pillars and hang down as wide, thin-walled sacs, which are nearly half as long as the radius of the umbrella (figs. 1, 8, 9, *gg*). They alternate with the four perradial arm curtains, which are twice the length, and like them, consist of an extremely delicate, thin-walled, transparent membrane. This gastrogenital membrane lies, like the arm curtains, in numerous longitudinal folds, as the peripheric cæcum of the gastrogenital pouches is of far larger extent then its narrow base of insertion. The long, narrow, genital band (fig. 10, *s*) lies at the bottom of the cæcum, fastened to its endodermal inner surface. The genital band is laid together in numerous windings, and folded thickly like a frill. The numerous, short, gastral filaments are spread not far from its proximal margin on the inner surface of the gastrogenital pouch (fig. 11, *f*). Stronger magnifying power shows us that each fold of the frill is composed of a very large number of small follicles (fig. 11, *sb*). The hollow spaces of these follicles, or the genital sinus, open into the gastrogenital pouch. The ripe sexual products fall first into the pouch, from which they pass into the stomach, and are finally emptied out through the mouth. They probably reach the exterior as in *Cyanea*, through the arm furrows in the folds of arm curtains, which shelter the fructified ova for some time, like a protective breeding pouch.

Third Sub-order of the Discomedusæ, RHIZOSTOMÆ, Cuvier, 1799.

Root-mouthed Discomedusæ. Discomedusæ with eight large, adradial, root-shaped, simple or branched oral arms, with numerous mouths of the funnel frills, without central oral opening and without tentacles.

Family, Crambessidæ, Hæckel, 1869.

Crambessidæ, Hæckel, System der Medusen, 1879, p. 614, taf. xxxviii., xxxix.

Rhizostomæ with a single, central, sub-genital porticus, and with both dorsal and ventral funnel frills of the eight oral arms. Discomedusæ without tentacles and without central oral opening; in place of it numerous small funnel openings form funnel frills both on ventral (axial) and on the dorsal (abaxial) sides of the eight oral arms. Eight sense clubs (four perradial and four interradial); eight to sixteen or more narrow radial canals, which are branched and by anastomosis form a vascular network in the subumbrella, usually with a distinct coronal canal. Four interradial genitalia in the aboral wall of a central subgenital porticus, which has arisen from centripetal fusion of four separate gastral, subgenital cavities.

Sub-family, Leptobrachidæ, L. Agassiz, 1862.

Crambessidæ without free upper arms, but with band-shaped, thin, greatly lengthened lower arms, which are naked for the most part, and only bear a tassel-shaped bunch of tuft-like funnel frills at the distal end.

Leonura,[1] Hæckel, 1879.

Crambessid without free upper arms, with band-shaped, very long, thin lower arms, which are naked for the most part, and only bear a bunch of funnel frills towards the distal end, above a naked terminal knob. The suture of the oral cross is eight-rayed, with eight adradial funnel frills, forming a special rosette of tufts round the centre of the arm disk.

The genus *Leonura* (or *Leontura*), along with the closely-allied genus *Leptobrachia*, compose the peculiar small group of the Leptobrachidæ. L. Agassiz erected them (1862) into a special family of the Rhizostomæ, whilst it seemed to me more to the purpose to attach them as a sub-family to the closely-allied family of the Crambessidæ (System, 1879, p. 630). This small group was hitherto known only by a single species, the *Rhizostoma leptopus* (from the Radack islands), of which Chamisso and Eysenhardt gave a tolerably good description in 1821 (Nova Acta Acad. Leop. Carol., tom. x. p. 356, pl. xxvii). In 1879, I myself described the Crambessida *Leonura leptura* from New Zealand as a closely-allied Rhizostom (System, 1879, p. 631). *Leonura terminalis* described below (the only Rhizostom of the Challenger expedition) differs somewhat from *Leonura leptura*. Whilst the structure of the umbrella only varies a little from *Crambessa*, the eight long thin arms are distinguished by the retrograde formation of the fused upper arms, and by the restriction of the funnel frills to the oral disk on the one side, and the distal half of the arms on the other; the proximal half of the arms lying between them, is naked and without frills.

Leonura terminalis, Hæckel (Pl. XXXII.).

Leonura terminalis, Hæckel, 1879, System der Medusen, p. 646, No. 616.

Umbrella depressed, with eighty marginal lobes (eight pointed triangular velar lobes between two small diverging ocular lobes in each octant). Subgenital ostia two to three times as broad as the intermediate pillars. Suture of the oral cross of the arm disk with a regular eight-rayed shaggy rosette. Arms moderately long and thin, band-shaped, triangular, nearly as long as the diameter of the umbrella, with a tassel-shaped, three-winged bunch of tufts, enclosing a projecting triangular, terminal knob without frills. Horizontal diameter, 80–90 mm.; vertical diameter, 30–70 mm.

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[1] Λέων=lion; οὐρά=a tail.

Habitat.—South-east part of the Pacific Ocean, not far from the island of Juan Fernandez. Station 229; lat. 33° 31′ S., long. 74° 43′ W. Depth, 2160 fathoms. 14th December 1875. (Taken at the same time as *Tesserantha connectens*, p. 50.) The specimen was pretty well preserved, but the arms were in great measure torn away.

The umbrella (figs. 1–4) forms a depressed disk, whose central part ("discus") is almost flat, whilst the coronal part ("corona") is sloped gently away. In radial section (fig. 2) we see that, as in all Monodemniæ (*Versuridæ* and *Crambessidæ*), the body consists of two separate principal parts only connected by the four perradial oral pillars, viz., the true umbrella disk (with gastral cavity and umbrella corona) and the underlying arm disk (with its pendant oral arms). The two principal parts are separated by the spacious central subgenital vestibule (*ir*) which opens freely to the exterior by four broad interradial subgenital apertures (figs. 1, 7, *ig*). The gelatinous substance of the umbrella resembles a soft cartilage in consistency, and is of tolerably equal thickness throughout (nearly 10 mm.), whilst it suddenly becomes thinned away towards the margin, and is only slightly developed on the lobes. The gelatinous substance of the arm disk is nearly as thick as that of the umbrella disk.

The exumbrella (figs. 1, 3) is distinguished by a delicate and tolerably regular tabulation, caused by the divisions by the net-shaped connected furrows, of the whole outer upper surfaces of the umbrella into polygonal areæ, projecting somewhat convexly, corresponding to the "pedalia" of *Nauphanta*, *Atolla*, and other Discomedusæ. The size of these exumbral areæ increases from the centre towards the periphery; the diameter of the inner areæ amounts to from 4–5 mm., that of the outer areæ from 6–8 mm.; the former are roundish, the latter extended polygonally, quadrangular, hexagonal, or octagonal. An octagonal central area (in the middle of the apex of the umbrella) is first surrounded by a corona of eight adradial areæ; next to these come a second corona of sixteen subradial areæ; the largest and most distinct areæ are thirty-two hexagonal, forming a circle, whose distal peripheric corresponds to the coronal canal on the subumbrella (fig. 3). The exumbral areæ become less distinct towards the lobe corona, the radial furrows between them pass into the incisions between the marginal lobes.

Eight sense clubs (four perradial and four interradial) are placed on the umbrella margin (figs. 3, 4), as in all Crambessidæ, and particularly in most Rhizostomæ. Each rhopalium is here enclosed by the two small pointed lanceolate, ocular lobes (or rhopalar lobes) which diverge outwards. The octants of the umbrella margin, which compose the lobed velarium, project in the form of shallow arches, between the eight receding rhopalar incisions of the umbrella margin. Between each two rhopalia there are eight triangular, pointed velar lobes, or more accurately four pairs; for the eight adradial and the sixteen subradial incissions of the umbrella margin, as well as the eight principal incisions in which the sense clubs lie, are deeper and stronger than the thirty-two shallower velar incisions inserted between the former and the latter. Moreover, as the adradial middle of the eight velar arches of the umbrella margin projects more strongly than its receding side parts, the sixteen pairs of velar lobes lying on both sides of the eight adradial canals appear larger than the sixteen pairs of weaker velar lobes lying on both sides of the eight principal canals (or of the eight rhopalia). If we add the sixteen smaller ocular lobes to this sixty-four velar lobes, the aggregate number of the marginal lobes amounts to eighty, as in many other Rhizostomæ.

The eight sense clubs show essentially the same conditions of situation, shape, size, and structure which Grenacher and Noll (1876) described minutely in *Crambessa tagi* (comp. also my System, pp. 458, 615, and Hertwig, Die Sinnesorgane der Medusen, 1878). They are acorn-shaped, and divided by a circular constriction into a club-shaped basal part and an oval distal part, the former contains the cæcal distal end of the ocular canal, the latter contains the otolite sac filled with numerous crystals. The sense clubs lie hidden in a subumbral rhopalar niche of the subumbrella, which is roofed over by a broad protective scale and enclosed laterally by the projecting sense folds ("plicæ rhopalares," *of*); these are the medial margins of the diverging ocular lobes or sense lobes which project like arches and overlap one another like a valve at their base. Above, on these subumbral surface, the roof-like projecting protective scale or protective plate is hollowed out by a cæcal funnel-shaped depression or olfactory funnel ("infundibulum olfactorium," *oz*), which is traversed by dendritically-branched folds ("olfactory folds"). Tentacles are entirely wanting in *Leonura* as in all other Rhizostoma.

The inner side of the umbrella (subumbrella, figs. 2, 4–7) and the umbrella cavity enclosed by it, show the same peculiar and remarkable conditions of structure in *Leonura*, which recur in all Rhizostomæ Monodemniæ (*Versuridæ* and *Crambessidæ*), and which were first described by Huxley (1849) in *Crambessa mosaica*, and later (1876) in detail by Grenacher and Noll in *Crambessa tagi* (comp. my System, pp. 472, 615, taf. xxxviii.–xl.). The subumbral umbrella cavity is divided into a peripheric umbrella coronal cavity and a central subgenital vestibule, which communicate only by the four broad interradial subgenital apertures (figs. 1, 7, *ig*). The latter are separated by the four strong oral pillars (figs. 2, 7, *ap*), the only connection between the umbrella disk and the arm disk. The coronal cavity of the umbrella forms a tolerably flat, broad coronal furrow of small extent. Its axial inner wall is formed by the external surface of the oral pillars (*ap*); its abaxial outer wall by the subumbral inner surface of the velarium or of the lobed umbrella corona.

The central subgenital vestibule ("porticus subgenitalis," fig. 2, *ir*) forms a spacious, though low chamber, whose base form is a quadrate prism. The upper wall or the roof of the vestibule is formed by the cruciform gastrogenital membrane and by the four interradial genital plates (fig. 4, *wi*) which fill the interspace between its perradial limbs. Looked at from above, the gastrogenital cross shines through the umbrella disk as in many other Rhizostomæ. The delicate gastrogenital membrane (figs. 2, 4, *gg*), formed by the cross, separates the vestibule from the underlying central stomach, of which it at the same time represents the bottom or lower wall. It consists of a very thin, flexible, and extensible fulcral plate, covered with gastral endoderm above and by subumbral ectoderm below; in the middle only it is strengthened by the gelatinous ridge cross (fig. 4, *gh*), whose four perradial limbs separate the four horseshoe-shaped genitalia from each other and pass at their distal end into the axial wall of the four oral pillars. The interradial interspaces between the four perradial limbs of the gastrogenital cross are filled by the four thick cartilage-like intergenital plates (fig. 4, *wi*); these are strong, equilaterally triangular thickenings of the gelatinous umbrella, having the interradial canals (*ci*) running in their middle line and the delicate gastrogenital membrane inserted at their lateral margins.

The four oral pillars (also termed arm pillars or floor pillars, "pilastri," figs. 2, 4, 7, *ap*) form the only connection between the upper and the lower wall of the subgenital vestibule, and are separated from each other by the four wide subgenital apertures. The oral pillars are four strong perradial gelatinous plates shaped like a parallel trapezum (fig. 7, *ap*). They spring with a narrower base, 10 mm. broad, from the distal end of the limb of the gastrogenital cross from above and outside to below, and inside expanding to a breadth of 15 mm. towards the arm disk which is formed by their confluence. The thickness of the arm pillars amounts to from 5–7 mm., their length to 15 mm. Their inner axial surface is curved concavely, their outer abaxial surface curved convexly, the former is turned towards the porticus, the latter towards the cavity of the umbrella corona. The broad perradial pillar canal (figs. 2, 4, 6, *cd*), the distal process of the limb of the gastral cross, runs in the solid gelatinous mass of the pillars, near their axial surface.

The four subgenital apertures (figs. 1, 7, *ig*) represent, in some measure, the four broad low doors, through which we reach from the outside (from the cavity of the umbrella cavity outwards) in the central vestibule. They are rectangular in form (with obtuse angles), are separated from each other laterally by the four perradial arm pillars, and therefore lie interradially. They are limited above by the distal basal part of the triangular intergenital plates, below by the lateral margin of the arm disk. The breadth, or the largest horizontal diameter of the subgenital aperture in its middle amounts to 25 mm., and is nearly three times as much as the smallest breadth of the pillars separating it.

The arm disk or oral disk ("stomodiscus, discus brachiferous," figs. 2, 6, 7, *ah*) represents the bottom of the floor or the lower wall of the subgenital vestibule. It is only connected with the overlying umbrella disk by the four arm pillars, and forms a thick gelatinous disk of the base form of a quadrate prism, nearly half as thick as broad, (40 mm. side length, by 16–18 mm. thick). If we transect two adjacent arm pillars at their base and then turn back the half-loosened arm disk, its upper or aboral surface which is turned towards the vestibule then becomes visible. It is quadratic and nearly flat, only arched somewhat convexly towards the middle, whilst it slopes away very gently outwards towards the lateral margins. The four perradial obtuse angles of the quadrate pass into the distal ends of the oral pillars; and the distal ends of the eight limbs of the genitalia (fig. 6, *sx*) (which rise in pairs on the axial wall of the pillar canals, *cd*) pass diverging, a little way on the oral surface of the arm disk. The lateral margins of the pillars are slightly indented in the middle, and form at once both the lower margins of the subgenital aperture (*ig*) and the distal margin of the four equilaterally triangular, slightly convex subgenital valves (fig. 6, *wv*); the latter are fused in some measure at their lateral margins with the oral processes of the pillars, and so form the arm disk.

The lower or oral surface of the oral disk is occupied by the frilled oral area ("area orealis"); the suture of the oral cross and the eight-rayed rosette of tufts covering it lies in the centre, whilst the eight arms run out round about it (fig. 7). The central rosette of tufts is actually formed by four pairs of tufted frills, which correspond to the four bifurcate branches of the four limbs of the oral suture, but the eight oral arms which go out in pairs from the bifurcation of the distal end of the four oral pillars divide at its bifurcated base so soon that they lie in the eight adradii almost from the first, and the rosette of tufts also assumes a nearly regularly eight-rayed form; as on the oral axial surface. The branched compacted bunch of tufts composing the rosette have the same structure as the funnel frills at the distal part of the arms. If we cut off the tufts, we see the regular suture of the oral cross ("sutura staurostomalis," fig. 1, *as*); as in all Rhizostoma, it has arisen from the fusion of the frilled margins of the cruciform oral opening, which is open at an early stage.

The eight oral arms in our *Leonura* show, on the whole, the same peculiar formation which was previously only known in *Leptobrachia leptopus* (=*Rhizostoma leptopus*, Chamisso, *loc. cit.*, pl. xxvii.). They appear as eight adradial, slender, band-shaped appendages of the arm disk, whose length nearly equals the diameter of the umbrella or only surpasses it a little. As in all Rhizostomæ multicrispæ (*Pilemidæ* and *Crambessidæ*), there are really two distinct principal parts on each arm, viz., the single-frilled upper arm and the three-frilled lower arm (System, p. 582). In the Leptobrachidæ, however, the short upper arm ("epibrachium") is quite rudimentary, and passed by concrescence into the formation of the thick oral disk. The whole free part of the arm is therefore formed here by the lower arm ("hypobrachium"). The proximal (upper) half of each lower arm is naked, and without frills, and consists of a thin, triangularly prismatic gelatinous band, whose three angles run out into three narrow wings, each of which show a canal in transverse section (fig. 3). The distal (lower) half of the lower arm consists of a frilled, tassel-shaped bunch of tufts, with a projecting, pointed, triangularly pyramidal terminal appendage or gelatinous knob at its end. The bunch of tufts is composed of three strongly frilled, many folded leaves, forming the distal process and expansion of the three angles of the arm. One of these three arm frills lies axially on the inner side of the arm, and appears as the distal part of the originally simple ventral frill, whose proximal part is an arm of the eight-rayed tuft rosette of the oral area; these two are separated from one another by the broad interspace of the naked upper half of the arm. The other two arm frills lie in pairs on the outer side of the arm, and so correspond to the dorsal frills of the Rhizostomæ multicrispæ (*Pilemidæ* and *Crambessidæ*, comp. my System, pp. 464, 581). Of the three narrow wings of the triangularly pyramidal terminal knobs, one also lies axially, and the other two abaxially; they are the terminal processes of the three frills, but they have lost their funnel frills, and look as if they had been ground down. The numerous and irregular oral openings on and between the folds of the frills are sometimes cleft-shaped, sometimes funnel-shaped; the margins of these funnel frills, which were formerly called sucking-mouths, are thickly beset with numerous microscopic small oral tentacles or digitella. Here in *Leonura*, as in all other Rhizostoma, there are "prolonged urticating papillæ of the ectoderm," solid cylindrical processes of the gelatinous substance of the arm, whose ectodermal epithelium partly forms thread cells, partly epithelial muscular cells (comp. Otto Hamann, Die Mundarme der Rhizostomen und ihre Anhangs-Organe; Jena. Zeitschr. für Naturw., Bd. xv. 1881).

The gastrovascular system (figs. 2, 4–8) of *Leonura* is almost completely homologous with that of the closely-allied *Leptobrachia*, and also in many respects with that of *Crambessa*, of which Grenacher and Noll (1876) have given a description which is very accurate and true to nature (comp. my System, 1879, p. 616, taf. xxxviii.–xl.). As in all Acraspedæ, we can distinguish the central principal intestine from the peripheric coronal intestine. The central principal intestine consists of the large cruciform central stomach and of the smaller buccal stomach connected with it by the four pillar canals and the vascular system of the arms, which runs out from the latter. The central stomach (figs. 2, 4, *gc*) has the cruciform shape and extent of the gastrogenital membrane already described (*gg*), which forms its lower wall; the upper wall is formed by the smooth endodermal surface of the central gelatinous umbrella disk. The sixteen radial canals composing the peripheric coronal intestine run towards the outside on the peripheric margin of the central stomach (*gm*), where its upper and wider walls touch, whilst, at the same time, the four perradial pillar canals ("canales pilastrales," *cd*) pass downwards. The latter spring from the distal ends of the four cross limbs of the central stomach, immediately below the starting point of the four perradial subumbral canals, run from above and outside, below and inside on the axial inner side of the four arm pillars, and these open into the buccal stomach (*ga*). We shall apply this name to the small cruciform hollow space found in the middle of the arm disk, and from which the eight arm canals run out downwards (*ch*). These lie adradially, but in pairs, above the eight limbs of the tufted rosette, and must be regarded as distal bifurcate branches of the four perradial pillar canals. Each arm canal immediately divides into three narrow canals, which run parallel to the ends of the three corners of the arm; one of them lies ventrally or axially, the two others dorsally or abaxially. Hence it comes that the whole free, triangular part of the arm must be regarded as the under arm; only the short basal part of the arm, containing a simple canal, which is fused with the arm disk, corresponds to the upper arm of the Rhizostomæ multicrispæ. Numerous branches run from the axial or ventral canals of the arms up to the tufts of the oral rosette (*ab'*) and down to the ventral funnel frill of the distal bunch of tufts (ab^3). The two axial or dorsal canals are only branched below, and this branch runs on the two dorsal funnel frills of the bunch of tufts. The distal ends of the three arm canals run in the three wings of the triangular terminal knobs so far as the point where they seem to open by a common terminal aperture.

The peripheric coronal intestine shows essentially the same conditions which I first described in *Crambessa tagi* (1869). Sixteen strong radial canals pass out from the periphery of the cruciform central stomach, run in the subumbrella to the umbrella margin, ramify thickly, and form a delicate, vascular network. Of the sixteen canals, the shortest are the four perradial, which spring from the distal end of the four limbs of the gastral cross (immediately above the four pillar canals), and which widen like an ampulla at their proximal base (fig. 4, *cp*). The four interradial canals are the longest; they spring from the corner between every two limbs of the gastral cross, and are beset with cæcal diverticula (fig. 4, *ci*). The eight adradial canals are shorter than the latter and stronger than the former; they spring from the two corners of the distal end of the limb and diverge in the form of an arch towards the umbrella margin. All the sixteen canals are connected by a strong coronal canal (fig. 4, *cc*). This lies in the subumbral coronal furrow, which separates the central umbrella disk from the velarium. The peripheric vascular network is divided by the coronal canal into two different sections, of which the narrower lies inside the coronal canal, and the broader outside. The intracircular vascular network is only 4–6 mm. broad, fills the space between coronal canal and the distal ends of the limbs of the cross in the form of a narrow zone, and consists of from three to four rows of loose meshes, irregularly polygonal in shape. The extracircular vascular network is three times as broad (12–16 mm.), consists of an extremely fine thin mesh work (whose finest meshes are hardly visible to the naked eye), and fills the whole subumbral side of the velarium, from the coronal canal, as far as the thin margin of the marginal lobes (fig. 4).

The genitalia (Pl. XXXII. figs. 1–6, *s*) in *Leonura* show, on the whole, the same conditions of form and structure which Grenacher and Noll (1876) described minutely in

Crambessa (*loc. cit.*). They form four narrow bands, folded thickly like a frill, and shaped like a horse-shoe, whose convex proximal arch projects centripetally in the interradius (fig. 4, *s*). The four reproductive bands lie in the delicate gastrogenital membrane, on the inner surface of the central bottom of the stomach, and are separated by a narrow interspace from the outer edge of the stomach (*gn*) on the one side, and from the four limbs of the gelatinous gastral cross (*gh*) on the other. When viewed from above (fig. 3), or from below (fig. 4), it almost looks as if the distal ends of the inverted limbs of each two adjacent arches of the horse-shoe, passed into one another at the distal end of the limbs of the gastral cross, and so formed a connected genital ring. Closer investigation, however, shows that the four interradial genitalia remain completely separated, although the ends of their limbs nearly touch on the axial surface of the perradial oral pillar. The last ends of the genital limbs are here bent down, diverging again laterally; they already lie in the four corners of the arm disk (fig. 6, *sx*). The specimen of *Leonura* examined was a male. The testes are laid in cross folds like a frill, in such a way that the whole genital band seems to consist of a large number of small fusiform sacs. These sacs (the tranverse folds of the horseshoe-shaped band of testes) lie thickly compacted, with their longitudinal axis perpendicular to that of the band; the sacs were slightly filled with ripe spermatozoa. The conditions of the finer structure in the genitalia, as in most other organs, resembled those of *Crambessa.*

SURVEY OF THE FAMILIES OF THE SYSTEM REPRESENTED AMONG THE DEEP-SEA MEDUSÆ OF THE CHALLENGER EXPEDITION.

Orders of the Medusæ.	Families of the System not Represented.	Families of the System Represented.	Species Described.
Order I. ANTHOMEDUSÆ (one species).	Codonidæ. Tiaridæ. Cladonemidæ.	Margelidæ (Pl. I.)	*Thamnostylus dinema*, p. 2.
Order II. LEPTOMEDUSÆ (one species).	Thaumantidæ. Eucopidæ. Æquoridæ.	Cannotidæ (Pl. II.)	*Ptychogena pinnulata*, p. 7.
Order III. TRACHOMEDUSÆ (three species).	Petasidæ. Aglauridæ. Geryonidæ.	Trachynemidæ (Pls. III.-VIII.)	*Pectyllis arctica*, p. 11. *Pectis antarctica*, p. 15. *Pectanthis asteroides*, p. 20.
Order IV. NARCOMEDUSÆ (four species).	Solmaridæ.	Cunanthidæ (Pl. IX.)	*Cunarcha æginoides*, p. 24.
		Peganthidæ (Pls. X.-XII.)	*Polycopla forskalii*, p. 31. *Pegantha pantheon*, p. 37.
		Æginidæ (Pls. XIII., XIV.)	*Æginura myosura*, p. 41.
Order V. STAUROMEDUSÆ (two species).	...	Tesseridæ (Pl. XV.)	*Tesserantha connectens*, p. 50.
		Lucernaridæ (Pls. XVI., XVII.)	*Lucernaria bathyphylla*, p. 54.
Order VI. PEROMEDUSÆ (two species).	Pericolpidæ.	Periphyllidæ, (Pls. XVIII.-XXV.)	*Periphylla mirabilis*, p. 64. *Periphema regina*, p. 85.
Order VII. CUBOMEDUSÆ (one species).	Chirodropidæ.	Charybdeidæ (Pl. XXVI.)	*Charybdea murrayana*, p. 93.
Order VIII. DISCOMEDUSÆ (four species).	Linergidæ. Pelagidæ. Flosculidæ. Ulmaridæ. Toreumidæ. Pilemidæ. Versuridæ.	Ephyridæ (Pls. XXVII.-XXIX.)	*Nauphanta challengeri*, p. 103. *Atolla wyvillii*, p. 113.
		Cyaneidæ (Pls. XXX., XXXI.)	*Drymonema victoria*, p. 125.
		Crambessidæ (Pl. XXXII.)	*Leonura terminalis*, p. 133.

SURVEY OF THE EIGHTEEN DEEP-SEA MEDUSÆ PREVIOUSLY DESCRIBED, GIVING THEIR HABITAT AND POSITION IN THE SYSTEM DER MEDUSEN.

GENUS AND SPECIES. OCEAN.	Station.	Depth in Fathoms.	Habitat.	
			Latitude.	Longitude.
1. *Thamnostylus dinema* (Pl. I.). Antarctic. Indian Order, Anthomedusæ; Family, Margelidæ; Sub-family, Thamnostomidæ.	153	120	65° 42′ S.	70° 49′ E.
2. *Ptychogena pinnulata* (Pl. II.). North Atlantic Order, Leptomedusæ; Family, Cannotidæ; Sub-family, Polyorchidæ.	50	1250	42 8 N.	63 39 W.
3. *Pectyllis arctica* (Pls. III., IV.). North Atlantic Order, Trachomedusæ; Family, Trachynemidæ; Sub-family, Pectyllidæ.	50	1250	42 8 N.	63 39 W.
4. *Pectis antarctica* (Pls. V., VI.). Antarctic. Indian Order, Trachomedusæ; Family, Trachynemidæ; Sub-family, Pectyllidæ.	152	1260	60 52 S.	80 20 E.
5. *Pectanthis asteroides* (Pls. VII., VIII.). Atlantic, Mediterranean Order, Trachomedusæ; Family, Trachynemidæ; Sub-family, Pectyllidæ.	(?) 4	600	36 25 N.	8 12 W.
6. *Cunarcha æginoides* (Pl. IX.). North Atlantic Order, Narcomedusæ; Family, Cunanthidæ; Sub-family, Cunoctonidæ.	354	1675	32 41 N.	36 6 W.
7. *Polycolpa forskalii* (Pl. X.). Pacific. Philippines Order, Narcomedusæ; Family, Peganthidæ; Sub-family, Polyxenidæ.	201	82	7 3 N.	121 48 E.
8. *Pegantha pantheon* (Pls. XI., XII.). Pacific. Philippines Order, Narcomedusæ; Family, Peganthidæ; Sub-family, Pegasidæ.	201	82	7 3 N.	121 48 E.
9. *Æginura myosura* (Pls. XIII., XIV.). Indian. Australian Order, Narcomedusæ; Family, Æginidæ; Sub-family, Æginuridæ.	159	2150	47 25 S.	130 32 E.
10. *Tesserantha connectens* (Pl. XV.). Pacific. Chili Order, Stauromedusæ; Family, Tesseridæ; Sub-family, Tesseranthidæ.	299	2160	33 31 S.	74 43 W.
11. *Lucernaria bathyphila* (Pls. XVI., XVII.). North Atlantic Order, Stauromedusæ; Family, Lucernaridæ; Sub-family, Haliclystidæ.	...	540	60 3 N.	5 51 W.
12. *Periphylla mirabilis* (Pls. XVIII.-XXIII.). Pacific. New Zealand Order, Peromedusæ; Family, Periphyllidæ; Sub-family, Periphemidæ.	168	1100	40 28 S.	177 43 E.
13. *Periphema regina* (Pls. XXIV., XXV.). Antarctic. Indian Order, Peromedusæ; Family, Periphyllidæ; Sub-family, Periphemidæ.	156	1975	62 26 S.	95 44 E.
14. *Charybdea murrayana* (Pl. XXVI.). Atlantic. Guinea Order, Cubomedusæ; Family, Charybdeidæ; Sub-family, Tamoyidæ.	348	200	3 10 N.	14 51 W.
15. *Nauphanta challengeri* (Pls. XXVII., XXVIII.). South Atlantic Order, Discomedusæ; Family, Ephyridæ; Sub-family, Nausithoidæ.	335	1425	32 24 S.	13 5 W.
16. *Atolla wyvillii* (Pl. XXIX.). Antarctic, Indian; and Antarctic, Atlantic Order, Discomedusæ; Family, Ephyridæ; Sub-family, Collaspidæ.	157 318	1950 2040	53 55 S. 42 32 S.	108 35 E. 56 27 W.
17. *Drymonema victoria* (Pls. XXX., XXXI.). Atlantic, Mediterranean Order, Discomedusæ; Family, Cyaneidæ; Sub-family, Drymonemidæ.	(?) 4	600	36 25 N.	8 12 W.
18. *Leonura terminalis* (Pl. XXXII.). Pacific. Chili Order, Discomedusæ; Family, Crambessidæ; Sub-family, Leptobrachidæ.	299	2160	33 31 S.	74 43 W.

GLOSSARY.

	A. Actinostoma.	Mouth.	Mund.
a	*Osculum.*	*Central aperture.*	*Osculum.*

Mouth opening of the Medusæ, derived from the primitive mouth (the archistome or blastopore of the gastrula); its margin forms the bounding line between the inner and outer germinal layers (endoderm and ectoderm); the inner (axial) surface of the œsophagus is covered with endoderm; the outer (abaxial) with ectoderm.

aa	Actinostoma, apertura oris.	Mouth aperture, oral opening.	Mundöffnung.
ab	Brachia oralia.	Oral arms.	Mundarme (perradial).
ac	Columnæ buccales.	Buccal columns.	Mundsäulen (interradial).
ad	Alæ oris adradiales.	Adradial oral wings.	Mundflügel (adradial).
ae	Fissuræ buccales.	Buccal clefts.	Schlundspalten.
af	Filamenta oralia (barbulæ).	Oral filaments.	Mundfäden.
ag	Glandulæ orales.	Oral glands.	Munddrüsen.
ah	Stomodiscus (discus oralis).	Oral plate, brachiferous plate.	Mundscheibe, Armscheibe.
ai	Tæniola oralia.	Oral tæniola.	Mundleisten (interradial).
ak	Costæ orales.	Buccal ribs.	Mundkanten (perradial).
al	Lobi orales.	Oral lobes.	Mundlappen (perradial).
am	Margo oralis.	Margin of the mouth.	Mundrand.
an	Crispæ orales suctoriæ.	Sucking frills (of the Rhizostomæ).	Saugkrausen (der Rhizostomen).
ao	Oscula suctoria.	Sucking pores (of the Rhizostomæ).	Saugmündchen (der Rhizostomen).
ap	Pilastri brachiales.	Oral pillars.	Mundpfeiler (perradial).
aq	Catablemata oralia.	Oral curtains.	Mundgardinen (perradial).
ar	Sulci orales.	Oral grooves.	Mundrinnen.
as	Stomostaurus (crux oralis).	Perradial oral cross.	Mundkreuz (perradial).
at	Tubus oralis.	Œsophagus.	Mundrohr.
au	Annulus oralis.	Oral ring (cartilaginous).	Mundring (knorpelig).
aw	Labia oralia.	Lips (interradial).	Lippenwülste (interradial).
ax	Axis oralis.	Central cavity of the mouth.	Mundaxenraum.
ay	Styli orales.	Oral styles.	Mundgriffel.
az	Digitella oralia.	Oral tentacles.	Mundtentakeln.

	B. Bursæ.	Pouches.	Taschen.
b	*Bursæ gastrocanales.*	*Chymiferous pouches.*	*Gefässtaschen.*

Broad, flat, pouch-shaped hollow spaces of the gastrovascular system, lined with endoderm; partly direct radial diverticula of the central gastral cavity, partly peripheric expansions of different parts.

ba	Bursæ adradiales.	Adradial pouches.	Adradialtaschen.
bb	Bursæ buccales.	Buccal pouches.	Backentaschen.
bc	Bursæ coronales.	Coronal pouches.	Kranztaschen.
bd	Bursæ alares.	Wing pouches.	Flügeltaschen.
bg	Bursæ gastrales.	Gastral pouches.	Magentaschen.
bi	Bursæ interradiales.	Interradial pouches.	Interradialtaschen.
bl	Bursæ lobares.	Lobe pouches.	Lappentaschen.
bm	Bursæ marginales.	Marginal pouches.	Randtaschen.
bo	Bursæ sensillares.	Pouches of the organs of sense.	Sinnestaschen.
bp	Bursæ perradiales.	Perradial pouches.	Perradialtaschen.
br	Bursæ radiales.	Radial pouches (in general).	Radialtaschen.
bs	Bursæ sexuales.	Genital pouches.	Geschlechtstaschen.
bt	Bursæ tentaculares.	Tentacular pouches.	Tentakeltaschen.
bu	Bursæ hipposideri.	Horseshoe-shaped pouches.	Hufeisentaschen.
bv	Bursæ velarii.	Pouches of the velarium.	Velartaschen.
bw	Bursæ mesenteriales.	Mesenteric pouches.	Mesogontaschen.
by	Bursæ pyloricæ	Pyloric pouches.	Pylorustaschen.

	C. CANALES.	CANALS.	CANÄLE.
c	*Gastrocanales,* *Tubi chymiferi.*	*Chymiferous tubes,* *Gastrovascular tubes, Vessels.*	*Gastrocanäle,* *Gefässe.*

Small, narrow, tube-shaped hollow spaces of the gastrovascular system, lined with endoderm; partly direct radial diverticula of the central gastral cavity, partly peripheric tubes running in various directions.

ca	Canales adradiales.	Adradial canals.	Adradial-Canäle.
cb	Canalis basalis.	Canal of the umbrella-peduncle.	Stiel-Canal (der Schirmkuppel).
cc	Canalis circularis.	Circular canal of the margin.	Ring-Canal am Schirmrande.
cd	Canales pilastrales.	Pillar canals (of the Rhizostomata).	Armpfeiler-Canäle (der Rhizostomen).
ce	Canales centripetales.	Centripetal canals.	Blinde Centripetal-Canäle.
cf	Canalis festivus.	Festoon canal (of the Narcomedusæ).	Feston-Canal (der Narcomedusen).
cg	Canales gastrales.	Gastral canals.	Magen-Canäle.
ch	Canales brachiales.	Brachial canals (Rhizostomata).	Arm-Canäle (Rhizostomen).
ci	Canales interradiales.	Interradial canals.	Interradial-Canäle.
ck	Canales perionales.	Peronial canals (Narcomedusæ).	Spangen-Canäle (Narcomedusen).
cl	Canales lobares.	Canals of the marginal lobes.	Lappen-Canäle.
cm	Canalis marginalis.	Marginal canal.	Rand-Canal.
cn	Canales ramales.	Branches of the canals.	Canal-Aeste.
co	Canales sensillares.	Sense canals.	Sinnes-Canäle.
cp	Canales perradiales.	Perradial canals.	Perradial-Canäle.
cr	Canales radiales.	Radial canals (in general).	Radial-Canäle.
cs	Canalis coronarius.	Coronal sinus.	Ring-Sinus.
ct	Canales tentaculares.	Tentacular canals.	Tentakel-Canäle.
cv	Canales velares.	Canals of the pseudo-velum.	Velar-Canäle.
cy	Canales clavares.	Canals of the marginal sense-clubs.	Canal der Randkolben.

D. ENTODERMA. ENDODERM. DARMBLATT.

d	*Entoderma,* *Lamina gastralis.*	*Hypoblast,* *Inner germinal layer.*	*Gastralblatt,* *Inneres Keimblatt.*

Internal primary germinal layer, corresponding to the internal simple germinal layer of the gastrula (or to the evaginated half of the blastula). In the Medusa it divides later into the permanent endoderm (or the epithelium of the gastrovascular system), the gelatinous mass (umbrella), and the supporting plates, &c.

da	Entoderma orale.	Oral endoderm.	Gastral-Epithel des Mundes.
dc	Entoderma canalis circularis.	Epithelium of the circular canal.	Gastral-Epithel des Ringcanals.
df	Entoderma filamentorum.	Epithelium of the gastral filaments.	Epithel der Gastral-Filamente.
dg	Entoderma gastrale.	Epithelium of the gastral cavity.	Inneres Magen-Epithel.
dk	Entoderma cathammale.	Endoderm of the lines of fusion.	Gefäss-Platte.
dl	Entoderma loborum.	Epithelium of the lobe pouches.	Epithel der Lappentaschen.
dp	Entodermatis plicæ et processus.	Folds and tufts of the endoderm.	Falten und Zotten des Entoderms.
dr	Entoderma canalium radialium.	Epithelium of the radial canals.	Epithel der Radial-Canäle.
ds	Entoderma sexuale (Acraspedarum).	Germinal epithelium of the sexual organs (of the Acraspeda).	Keim-Epithel der Geschlechts-Organe (der Acraspeden).
dt	Entoderma tentaculorum.	Inner epithelium of the hollow tentacles.	Gastral-Epithel der hohlen Tentakeln.
du	Entoderma umbrale.	Dorsal epithelium of the canals.	Epithel der dorsalen Canal-Wand.
dw	Entoderma subumbrale.	Ventral epithelium of the canals.	Epithel der ventralen Canal-Wand.
dz	Entodermatis cellulæ chordales.	Notochordal cells of the solid tentacles.	Entodermale Chordal-Zellen (Axe der soliden Tentakeln).

E. EXUMBRELLA. EXUMBRELLA. AUSSENSCHIRM.

e	*Paries umbrellæ dorsalis,* *Ectophragma.*	*Dorsal wall,* *Outer (convex) wall of the umbrella.*	*Rückenwand,* *Aeussere (convexe) Schirmwand.*

External or upper wall of the gelatinous umbrella, covered by a dorsal ectodermal epithelium; arched more or less convexly, corresponding to the calyx of polyps. It is divided by the umbrella margin from the subumbrella.

ea	Costæ adradiales.	Adradial ribs.	Adradiale Rippen.
ec	Fossa circularis.	Circular furrow of the exumbrella.	Ringfurche.
eg	Gyri radiales.	Radial gyri.	Radial-Wülste.
ei	Costæ interradiales.	Interradial ribs.	Interradiale Rippen.
el	Fossa lobaris.	Radial furrow of the marginal lobes.	Lappenfurche.
en	Peronia tentaculorum.	Clasps of the tentacles.	Schirmspangen (der Narcomedusen).
eo	Crypta rhopalaris.	Niche of the rhopalium.	Sinnesnische.
ep	Costæ perradiales.	Perradial ribs.	Perradiale Rippen.
er	Costæ radiales.	Radial ribs (in general).	Radial-Rippen.
es	Sulci radiales.	Radial furrows (of the exumbrella).	Radial-Furchen.

	F. FILAMENTA.	GASTRAL-FILAMENTS.	GASTRALFILAMENTE.
f	*Filamenta gastralia,* *Digituli gastrales,* *Tentacula gastralia.*	*Digitate bodies,* *Digitate appendages,* *Gastral tentacles.*	*Magenfäden,* *Magen-Tentakeln,* *Genital-Tentakeln.*

Finger-shaped processes of the gastral wall, projecting freely into the hollow space of the gastrovascular system, and consisting of solid threads (or tufts of the gelatinous matter of the disk) whose free upper surface is covered by an endodermal epithelium; this is differentiated into flagellate cells, thread cells, glandular cells, and epithelial muscular cells.

fa	Filamenta gastris oralis.	Tentacles of the buccal stomach.	Orale-Magenfäden.
fb	Filamenta gastris basalis.	Tentacles of the basal stomach.	Basale Magenfäden.
fc	Crura tæniolorum.	Branches of the gastral ridges.	Schenkel der Magenleisten.
fg	Filamenta gastris centralis.	Tentacles of the central stomach.	Centrale Magenfäden.
fp	Filamentorum phacelli.	Bunches of filaments.	Filament-Bündel.
ft	Tæniola gastralia.	Ridges of the stomach.	Magenleisten (interradial).

	G. GASTER.	STOMACH.	MAGEN.
g	*Stomachus,* *Cavitas centralis.*	*Central cavity,* *Main cavity.*	*Centralhöhle,* *Haupthöhle.*

The central principal cavity of the body, sometimes discoid, sometimes bell-shaped, whose central vertical axis also forms the principal axis of the Medusa body. The upper (dorsal or umbral) wall of the gastral cavity is always formed by the solid gelatinous mass of the umbrella (covered by the flat epithelium of the dorsal endoderm), while the lower (ventral or subumbral) wall is formed by the central part of the subumbrella (covered by the high epithelium of the subumbral endoderm); the manubrium opens in the centre of the lower wall.

ga	Gaster oralis.	Oral stomach.	Schlundmagen.
gb	Gaster basalis.	Basal stomach.	Grundmagen.
gc	Gaster centralis.	Central stomach.	Mittelmagen.
gd	Glandulæ gastrales.	Glands of the stomach.	Magendrüsen.
gf	Fundus gastris.	Bottom of the stomach.	Magen-Boden, Magengrund.
gg	Membrana gastro-genitalis.	Gastrogenital membrane.	Gastrogenital-Membran.
gh	Crux gastro-genitalis.	Cross of the same membrane.	Leistenkreuz dieser Membran.
gk	Gastris nodi palatini (perr.)	Nodes of the palate.	Gaumenknoten.
gl	Lamina gastralis.	Endoderm-lamella.	Magen-Gefässblatt.
gm	Gastris margo periphericus.	Periphery of the stomach.	Magen-Umkreis.
gn	Antra gastris basalis (perr.)	Niches of the basal stomach.	Nischen des Grundmagens.
go	Ostia gastralia (perrad.)	Openings of the stomach.	Gastral-Ostien.
gp	Gastris porta palatina	Palatine door.	Gaumenpforte.

gr	Gastris sulci basales (perr.)	Gastral basal furrows.	Magen-Grundrinnen.
gs	Gastris sulci palatini (perr.)	Furrows of the palate.	Gaumenrinnen.
gt	Tubus gastralis.	Gastral tube.	Magenrohr.
gu	Paries gastris umbralis.	Umbral wall of the stomach.	Dorsalwand des Magens.
gv	Gastris valvulæ palatinæ (perr.)	Valves of the palate.	Gaumenklappen.
gw	Paries gastris subumbralis.	Subumbral wall of the stomach.	Ventral-Wand des Magens.
gx	Gastris sulci exumbrales (inter.)	Interradial furrows of the stomach.	Interradiale Längsfurchen des Magens.
gy	Pylorus (porta pylorica).	Pyloric door.	Magenpforte.
gz	Laminæ obelisci.	Obelisk plates of the central stomach.	Obeliskenplatten des Central-Magnes.

H. ANTRUM. UMBRELLA-CAVITY. SCHIRMHÖHLE.

h	*Caverna umbrellæ.*	*Cavity of the nectocalyx.*	*Schwimmhöhle.*

An open cavity under the concave umbrella, vaulted over by the subumbrella, and opening freely below (or only partially closed at the margin by the circular velum). The oral organs always lie in the central axial space of the umbrella cavity. All the walls of the umbrella cavity are covered by the ectodermal epithelium of the subumbrella.

ha	Apertura antri.	Opening of the nectocalyx.	Mündung der Schirmhöhle.
hb	Basis antri.	Floor of the nectocalyx.	Grund der Schirmhöhle.
hl	Antra loborum marginalium.	Cavities of the marginal lobes.	Lappen-Höhlen (der Narcomedusen).
hr	Recessus antri.	Niches of the nectocalyx.	Nischen der Schirmhöhle.

i I. INFUNDIBULA. FUNNEL-CAVITIES. TRICHTERHÖHLEN.

Open cavities lined by the ectodermal epithelium of the subumbrella, which are merely various kinds of processes, lateral spaces or secondary cavities of the umbrella cavity (Antrum).

ia	Apex infundibuli.	Summit of the funnel.	Trichterspitze.
ib	Infundibula basalia.	Basal funnels.	Basal-Trichter.
ig	Ostia subgenitalia.	Apertures of the subgenital cavities.	Oeffnungen der Subgenital-Höhlen.
ii	Infundibula interradialia.	Interradial funnels.	Interradiale Trichter.
il	Infundibula loborum.	Funnels of the marginal lobes.	Lappen-Trichterhöhlen.
io	Infundibula oralia.	Oral funnels (outer buccal pouches).	Mundtrichter (äussere Backentaschen).
ip	Infundibula peduncularia.	Funnels of the peduncle.	Stieltrichter.
ir	Porticus subgenitalis.	Central subgenital vestibule.	Subgenital-Saal (der Monodemnien).
is	Infundibula subgenitalia.	Subgenital cavities (funnel cavities of the umbrella).	Subgenitahöhlen (Schirmtrichterhöhl).
it	Infundibula tentaculorum.	Funnels of the tentacles.	Tentakel-Trichterhöhlen.
iv	Infundibula velaria.	Funnels of the velarium.	Velar-Trichter (der Cubomedusen).

	K. CATHAMMATA.	LINES OF FUSION.	VERLÖTHUNGEN.
k	*Concrescentiæ,* *Partes concretæ.*	*Fused parts,* *Plates.*	*Concrescenz-Platten,* *Verwachsungs-Stellen.*

Places at which the two walls of the peripheric gastrovascular system (umbral or dorsal wall and subumbral or ventral wall) are fused or grown together; they sometimes form round knobs (nodi), sometimes line-like selvages (septa), sometimes flat plates (laminæ). Each cathamma, or junction, always consists originally of two epithelial plates of the endoderm, which are, however, often fused into a single layer of cells.

kl	Loborum cathammata.	Fused clasps of the marginal lobes.	Lappen-Spangen.
kn	Nodi cathammales.	Fused nodes.	Verwachsungs-Knoten.
kt	Tabulæ cathammales.	Fused plates.	Verwachsungs-Tafeln.
ks	Limites cathammales.	Fused ridges.	Verwachsungs-Leisten.

	L. LOBI.	LOBES.	LAPPEN.
l	*Lobi marginales umbrellæ.*	*Marginal lobes of the umbrella.*	*Lappen des Schirmrandes.*

Leaf-shaped processes of the umbrella margin, separated by clefts in the margin, and usually containing peripheric processes of the gastrovascular system. The true marginal lobes (homologous to tentacles) are only found in the section Ascraspeda; whilst the false marginal lobes, which sometimes appear in the Craspedota (in the Narcomedusæ) are formed in quite a different way (gelatinous lobes, arising from the development of the peronia).

la	Lobi adradiales.	Adradial lobes.	Adradiale Randlappen.
lm	Lobi marginales.	Marginal lobes.	Randlappen.
ll	Lobuli velares.	Lobules of the velar lobes.	Läppchen der Velar-Lappen.
lo	Lobi oculares.	Ocular lobes.	Augenlappen.
lp	Patagium lobare.	Border membrane of the lobes.	Randsaum der Lappen.
ls	Paries loborum subumbralis.	Concave inner side of the lobes.	Ventral-Wand der Lappen.
lt	Lobi tentaculares.	Tentacular lobes.	Tentakel-Lappen.
lu	Paries loborum umbralis.	Convex outer side of the lobes.	Dorsal-Wand der Lappen.
lv	Lobi velares.	Lobes of the pseudo-velum.	Velar-Lappen.

m	M. MUSCULI.	MUSCLES.	MUSKELN.

By far the larger part of the muscles of the Medusæ belong to the subumbrella, and are produced by its ventral ectodermal epithelium; the dorsal muscles which are formed from the ectodermal epithelium of the exumbrella, and the gastral muscles which are formed from the endodermal epithelium of the subumbral gastrovascular wall are much less important.

ma	Musculi adradiales.	Adradial muscles.	Adradiale Muskeln.
mb	M. buccales.	Buccal muscles.	Backenmuskeln.
mc	M. coronarius.	Coronal muscle.	Kranzmuskel.
md	M. deltoidei.	Deltoid muscles.	Deltamuskeln.
md'	M. delt. perradiales.	Perradial deltoid muscles.	Perradiale Deltamuskeln.
md''	M. delt. interradiales.	Interradial deltoid muscles.	Interradiale Deltamuskeln.
me	M. exumbrales.	Muscles of the exumbrella.	Muskeln der Exumbrella.
mf	M. filamentorum.	Muscles of the gastral filaments.	Muskeln der Gastral-Filamenta.
mg	M. gastrales.	Gastral muscles.	Muskeln der Magenwand.
mg'	M. gastrales longitudinales.	Longitudinal muscles of the stomach.	Längsmuskeln der Magenwand.
mg''	M. gastrales circulares.	Transverse muscles of the stomach.	Ringmuskeln der Magenwand.
mh	M. loborum marginalium.	Muscles of the lobes.	Längsmuskeln der Randlappen.
mi	M. interradiales.	Interradial muscles.	Interradiale Muskeln.
mk	M. radicales tentaculorum.	Muscles at the bases of the tentacles.	Wurzelmuskeln der Tentakeln.
ml	M. longitudinales.	Longitudinal muscles.	Längsmuskeln.
mm	M. marginalis.	Marginal muscle.	Randmuskel.
mn	M. congenitales.	Congenital muscles.	Congenitale Muskeln.
mo	M. orbicularis.	Circular muscle of the mouth.	Ringmuskel des Mundes.
mp	M. perradiales.	Perradial muscles.	Perradiale Muskeln.
mq	M. codonoides.	Muscle of the swimming bell.	Glocken-Muskel.
mr	M. radiales.	Radial muscles (in general).	Radial-Muskeln.
ms	M. intergenitales.	Intergenital muscles.	Intergenital-Muskeln.
mt	M. tentaculorum longitudinales.	Longitudinal muscles of the tentacles.	Längsmuskeln der Tentakeln.
mv	M. veli vel *velarii* (circulares).	Circular muscles of the velum.	Ringmuskeln des Velum.
mw	M. subumbrellæ circulares.	Circular muscles of the subumbrella.	Ringmuskeln der Subumbrella.
mz	M. zonaris exumbrellæ.	Circular muscle of the exumbrella.	Gürtel-Muskel der Exumbrella.

N. NEMATILLÆ. URTICATING ORGANS. NESSELORGANE.

n	*Urticantia.*	*Stinging bodies.*	*Nesselkörper.*

Organs of different shapes, consisting of one or more thread cells, usually groups of accumulated thread cells; stinging knobs, stinging bands, stinging plates.

na	Nematillæ oris.	Urticating knobs of the mouth.	Nesselknöpfe des Mundes.
nc	Marginis circulus nematalis.	Urticating ring of the umbrella-margin.	Nesselring des Schirmrandes.
ne	Nematillæ exumbrellæ.	Urticating knobs of the exumbrella.	Nesselknöpfe der Exumbrella.
nf	Fila nematalia.	Urticating threads.	Nesselfäden.
nk	Cystæ urticantes.	Nematocysts, thread cysts.	Nesselkapseln.
nm	Nematillæ marginis.	Marginal thread cells.	Nesselzellen des Schirmrandes.
np	Nematillæ peronii.	Peronial thread cells.	Nesselzellen der Schirmspangen.
ns	Nematillæ sexuales.	Thread cells of the genitalia.	Nesselzellen der Gonaden.
nt	Nematillæ tentaculorum.	Thread cells of the tentacles.	Nesselorgane der Tentakeln.
nw	Nematillæ subumbrellæ.	Thread cells of the subumbrella.	Nesselzellen der Subumbrella.
nz	Cellulæ nematales.	Thread cells.	Nesselzellen.

O. SENSILLÆ. SENSE ORGANS. SINNESORGANE.

o *Corpuscula marginalia.* *Marginal bodies.* *Randkörper.*

Sense organs of various kinds, placed for the most part on the umbrella margin; organs of feeling, smelling, hearing, and seeing; sometimes single, sometimes united into sense clubs, &c. The essential sensitive part of all organs of sense always consist of variously differentiated ectodermal cells, whilst the endoderm cells may also have a share in the formation of the subordinate parts.

oa	Ampulla rhopalaris.	Bladder of the rhopalia.	Ampulle der Sinneskolben.
ob	Claves marginales.	Marginal clubs.	Randkeulen.
oc	Ocellus.	Eye speck.	Auge.
od	Lens crystallina.	Lens of the eye.	Dioptrische Linse.
of	Plicæ rhopalares.	Sense folds.	Sinnesfalten.
og	Ganglion acusticum.	Auditory ganglion.	Hör-Ganglion.
oh	Setulæ auditivæ.	Auditory hairs.	Hörhäärchen.
ok	Cordyli.	Auditory clubs.	Hörkölbchen (acustische Tentakeln).
ol	Otolithi.	Otolites.	Hörsteinchen.
on	Antrum rhopalare.	Niche of the rhopalium.	Nische der Sinneskolben.
oo	Otoporpæ.	Clasps of the cordyli.	Hörspangen (der Narcomedusen).
op	Pulvinar pigmentosum.	Pigmented pad of the rhopalia.	Pigmentpolster der Rhopalien.
or	Rhopalia.	Sense clubs.	Sinneskolben (der Acraspeden).
os	Squama rhopalaris.	Protective scale of the rhopalium.	Deckschuppe der Sinneskolben.
ot	Otocystæ.	Auditory vesicles.	Hörbläschen.
ov	Vesiculæ velares.	Marginal vesicles.	Randbläschen (der Leptomedusen).
oz	Infundibulum olfactorium.	Olfactory funnel.	Riechgrube.

P. PEDUNCULUS. PEDUNCLE. SCHIRMSTIEL.

p *Processus cupularis.* *Apical process of the umbrella.* *Scheitel-Aufsatz des Schirms.*

Conical or pyramidal aboral process of the umbrella, sometimes prolonged into a long cylinder or a quadrangular prism, homologous to the peduncle of the gonophores. The peduncle is sometimes fixed at the end (in the sessile Lucernaridæ), sometimes pointed and free (in the swimming Codonidæ, Tesseridæ, &c.).

pa	Axis pedunculi.	Central canal of the peduncle.	Centraler Axenraum des Schirmstiels.
pb	Basis pedunculi.	Adherent caudal disc.	Basis des Schirmstiels.
pc	Costæ pedunculi.	Ribs of the peduncle.	Rippen des Schirmstiels.
ps	Sulci pedunculi.	Furrows of the peduncle.	Rinnen des Schirmstiels.
pt	Apex pedunculi.	Top of the peduncle.	Spitze des Schirmstiels.

Q. EXODERMA. ECTODERM. HAUTBLATT.

q *Ectoderma, Lamina dermalis.* *Epiblast, Outer germinal layer.* *Dermalblatt, Acusseres Keimblatt.*

The external primary germinal layer, corresponding to the external simple germinal layer of the gastrula (or the non-invaginated half of the blastula). In the Medusæ this germinal layer is divided later into the permanent ectoderm (or the external epithelium of the whole body), and the muscles, &c., produced by it.

qa	Exoderma orale.	Oral ectoderm.	Exoderm-Epithel des Mundes.
qe	Exoderma exumbrellæ.	Ectoderm of the exumbrella.	Exoderm-Epithel der Exumbrella.
qg	Exoderma gastrale.	Gastral ectoderm.	Exoderm-Epithel des Magens.
qs	Exoderma sexuale (Craspedotarum).	Sexual epithelium of the Craspedota.	Keim-Epithel der Geschlechts-Organe (der Craspedoten).
qt	Exoderma tentaculorum.	Ectoderm of the tentacles.	Epithel der Tentakeln.
qw	Exoderma subumbrellæ.	Ectoderm of the subumbrella.	Exoderm-Epithel der Subumbrella.

r R. Nervi. Nerves. Nerven.

Whilst the peripheric nervous system of the Medusæ consists of a diffused plexus, extending far under the ectoderm, and connected with it, a ring of nerves, which is double in the Craspedota and simple in the Acraspeda, with ganglionic swellings at the organs of sense, appears as a central part at the umbrella margin.

rc	Circulus nervosus.	Nerve ring.	Nervenring des Schirmrandes.
rc′	Circulus nervosus exumbralis.	Upper nerve ring.	Dorsaler Nervenring.
rc″	Circulus nervosus subumbralis.	Lower nerve ring.	Ventraler Nervenring.
rg	Plexus nervosus gastralis.	Nervous plexus of the stomach.	Nerven-Plexus des Magens.
ro	Nervi sensillares.	Nerves of the sense organs.	Sinnesnerven.
rs	Plexus nervosus subumbralis.	Nervous plexus of the subumbrella.	Nerven-Plexus der Subumbrella.

S. Sexualia. Reproductive Organs. Geschlechtsorgane.

s *Genitalia.* *Genitalien.*

The reproductive organs of all Medusæ consist essentially of reproductive glands or gonads, which are developed in both sexes from the ectoderm in the Craspedota, and from the endoderm in the Acraspeda.

sa	Apertura genitalis.	Genital aperture.	Geschlechts-offnung.
sb	Folliculi sexuales.	Genital follicles.	Gonaden-Bläschen.
sc	Cavitas gonadum.	Cavity of the genital sacs.	Höhle der Geschlechtsbeutel.
sd	Epithelium gastrale gonadum.	Inner epithelium of the genitalia.	Entoderm-Epithel der Gonaden.
se	Lobi gonadum.	Lobes of the genital glands.	Lappen der Geschlechtsdrüsen.
sf	Gonades femininæ.	Ovaries.	Eierstöcke
sg	Gonades.	Reproductive glands.	Geschlechtsdrüsen.
sm	Gonades masculinæ.	Testes.	Hoden.
so	Ova.	Ova.	Eier.
sp	Plicæ genitales.	Genital folds.	Geschlechtsfalten.
ss	Sinus genitalis.	Genital sinus.	Geschlechtsbucht.
st	Sterigma genitale.	Supporting frame of the genitalia.	Fulcral-Gerüste der Gonaden.
sw	Epithelium subumbrale gonadum.	Outer epithelium of the genitalia.	Exoderm-Epithel der Gonaden.
sz	Zoospermia.	Spermatozoa.	Samenfäden.

t T. TENTACULA. TENTACLES. TENTAKELN.

The corona of tentacles in the Medusæ corresponds originally to that of the nearly related Polyps, and is therefore placed on the margin of the umbrella in the Medusæ, as it is on the margin of the peristome in the Polyps; in many Medusæ, however, the tentacles assume a secondary position, and are sometimes transferred to the dorsal, sometimes to the ventral surface of the umbrella.

ta	Tentacula adradialia.	Adradial tentacles.	Adradiale Tentakeln.
tb	Tentaculorum bulbi basales.	Basal bulbs of the tentacles.	Basale Tentakel-Bulben.
tc	Tentacula cava.	Hollow tentacles.	Hohle Tentakeln.
td	Tentacula solida.	Solid tentacles.	Dichte Tentakeln.
te	Cirri spirales.	Spiral cirri.	Spiral-Fäden.
ti	Tentacula interradialia.	Interradial tentacles.	Interradiale Tentakeln.
tk	Tentacula ancoralia.	Margin anchors or marginal papillæ.	Randanker oder Randpapillen.
tp	Tentacula perradialia.	Perradial tentacles.	Perradiale Tentakeln.
tr	Tentaculorum radices.	Roots of the tentacles.	Tentakel-Wurzeln.
ts	Tentacula suctoria.	Suckers.	Saugnäpfe.

U. UMBRELLA. UMBRELLA. SCHIRM.

u	*Discus, campana,* *Discus gelatinosus.*	*Disc, bell,* *Gelatinous disk.*	*Scheibe, Glocke,* *Gallertscheibe.*

The gelatinous concavo-convex disk, the most voluminous part of the Medusa, and in most cases forming the principal part of the body; the upper convex surface (exumbrella) passes into the lower concave surface (subumbrella), at the margin of the umbrella.

ua	Umbrellæ pedalia adradialia.	Adradial pedalia.	Adradiale Schirm-Pedale.
uc	Umbrellæ conus (cupula).	Cone of the umbrella.	Schirmkegel (Schirmkuppel).
ud	Umbrellæ pedalia.	Pedalia of the umbrella.	Schirm-Pedale.
uf	Umbrellæ fibrillæ elasticæ.	Elastic fibrillæ of the gelatinous disk.	Elastische Fasern der Schirm-Gallerte.
ug	Umbrellæ gelatina.	Gelatinous substance of the umbrella.	Schirm-Gallerte.
ui	Umbrellæ pedalia interradialia.	Interradial pedalia.	Interradiale Schirm-Pedale.
uk	Umbrellæ conus lingualis.	Tongue-like cone of the umbrella.	Zungenkegel oder Gastralkegel.
um	Margo umbralis.	Margin of the umbrella.	Schirmrand.
up	Umbrellæ pedalia perradialia.	Perradial pedalia.	Perradiale Schirm-Pedale.
us	Pedunculus gastralis.	Gelatinous peduncle of the stomach.	Magenstiel (gallertiger, solider Stiel).
ut	Tubercula umbrellæ.	Tubercles of the umbrella.	Schirmhöker.
uz	Umbrellæ corona.	Corona of the umbrella.	Peripherer Schirmkranz.

v V. VELUM. VELUM. RANDHAUT.

A muscular, thin, membranous ring, which, in the section of the Craspedota, projects freely downwards and inwards from the umbrella margin, as a process of the subumbrella. The velarium (or pseudo-velum), which is found in some Acraspeda, is a similar but essentially different structure.

va	Velarium (Acraspedarum).	Pseudo-velum (of some Acraspeda).	Velum-ähnliche Randmembran.
vb	Veli basis.	Basal edge of the velum.	Insertions-Rand des Velum.
ve	Velum exumbrale.	Dorsal surface of the velum.	(Untere) Dorsalfläche des Velum.
vf	Velarii frenula (perradiale).	Suspensors of the velum.	Suspensorien des Velarium.
vm	Veli margo.	Free margin of the velum.	Freier Axial-Rand des Velum.
vw	Velum subumbrale.	Ventral surface of the velum.	(Obere) Ventral-Fläche des Vellum.

	W. SUBUMBRELLA.	SUBUMBRELLA.	INNENSCHIRM.
w	*Paries umbrellæ ventralis,* *Opsophragma,* *Nectocalyx.*	*Lower wall of the umbrella,* *Nectosac, nectocalyx,* *Swimming sac.*	*Bauchwand,* *Inner (concave) Schirmwand,* *Schwimmsack.*

The inner or lower ventral wall of the gelatinous umbrella, covered by the ventral ectodermal epithelium with an underlying circular muscular layer; it is vaulted more or less concavely, and corresponds to the peristomial plate of the polyps.

wc	Plicæ circulares subumbrales.	Circular folds of the subumbrella.	Ringfalten der Subumbrella.
wf	Frenula subumbralia.	Radial folds of the subumbrella.	Verticale Falten der Subumbrella.
wi	Tabulæ intergenitales.	Intergenital plates (Rhizostomæ).	Intergenital-Tafeln der Subumbrella (Rhizostomen).
wr	Mesenteria (vel Mesogonia).	Circumoral buttresses (perradial) or mesenteric folds.	Gekrösplatten oder Mesenterial-Falten.
ws	Sulci circulares subumbrales.	Circular furrows (between the folds of the subumbrella).	Ringfurchen (zwischen den Ringfalten der Subumbrella).
wv	Valvulæ subgenitales.	Subgenital valves (of the Rhizostomæ).	Subgenital-Klappen (der Rhizostomen).

x	X. ORGANA VARIA EXODERMALIA.	VARIOUS ORGANS OF THE ECTODERM.	VERSCHIEDENE ORGANE DES EXODERMS.

y	Y. ORGANA VARIA ENTODERMALIA.	VARIOUS ORGANS OF THE ENDODERM.	VERSCHIEDENE ORGANE DES ENTODERMS.

	Z. FULTURA.	SUPPORTING PLATE.	STÜTZPLATTE.
z	*Lamina fulcralis,* *Lamina basalis.*	*Chondrophys,* *Fulcral plate.*	*Stützlamelle,* *Fulcral-Platte.*

A structureless hyaline membrane lying immediately under the epithelium of the endoderm, and excreted by it (more rarely a local production of the ectoderm, as for example in the velum). The supporting plate is sometimes thin but firm, like an elastic plate, sometimes thicker but softer, as a direct process of the gelatinous mass of the umbrella.

za	Fultura actinostomatis.	Supporting plate of the mouth.	Stützplatte des Mundes.
zg	Fultura gastralis.	Supporting plate of the stomach.	Stützplatte des Magens.
zk	Fultura cathammalis.	Supporting plate of the soldered nodes.	Stützplatte der Concrescenz-Knoten.
zl	Fultura loborum.	Supporting plate of the marginal lobes.	Stützplatte der Randlappen.
zt	Fultura tentaculorum.	Supporting plate of the tentacles.	Stützplatte der Tentakeln.
zv	Fultura veli (aut velarii).	Supporting plate of the velum (or velarium).	Stützplatte des Velum (oder Velarium).
zw	Fultura subumbrellæ.	Supporting plate of the subumbrella.	Stützplatte der Subumbrella.
zz	Fultura umbrellæ.	Supporting plate of the umbrella.	Stützplatte der Umbrella.

PLATE I.

THAMNOSTYLUS DINEMA.

Fig. 1.—The entire Medusa, five times the natural size, seen from the side. The long quadrangularly prismatic œsophagus, which is circularly constricted above the oral opening, projects in the middle far out from the opening of the umbrella cavity. The œsophagus is surrounded by the numerous branches of the four powerful, dichotomously branched, blood-red oral styles, whose terminal branches bear an urticating knob. The four leaf-shaped, pinnated genitalia are seen above the oral styles in the side walls of the inverted pyramidal central stomach. The four narrow radial canals run out from the base of the central stomach and are united into a coronal canal at the umbrella margin above the pigmented urticating ring. A pigmented ocellar bulb lies below its opening. Two long tentacles, furnished with urticating rings, run out from two opposite bulbs.

Fig. 2.—Umbrella seen from above, four times the natural size. *gc* Central stomach. *s* Genitalia (ovaria). *gx* Interradial furrow of the gastral wall. *cr* Radial canals. *cc* Coronal canals. *mi* Interradial longitudinal muscles of the subumbrella. *v* Velum. *ug* Gelatinous substance of the umbrella. *ne* Urticating knobs of the umbrella.

Fig. 3.—The central stomach, seen from below, eight times the natural size, with the œsophagus (*at*) and the four oral styles (*ay*) cut off at their bases. The four leaf-shaped, pinnated genitalia (*sf*) cover the greater part of the wall of the stomach (*gc*). Four perradial internal gastral grooves (*gs*) alternating with four interradial external gastral furrows (*gx*).

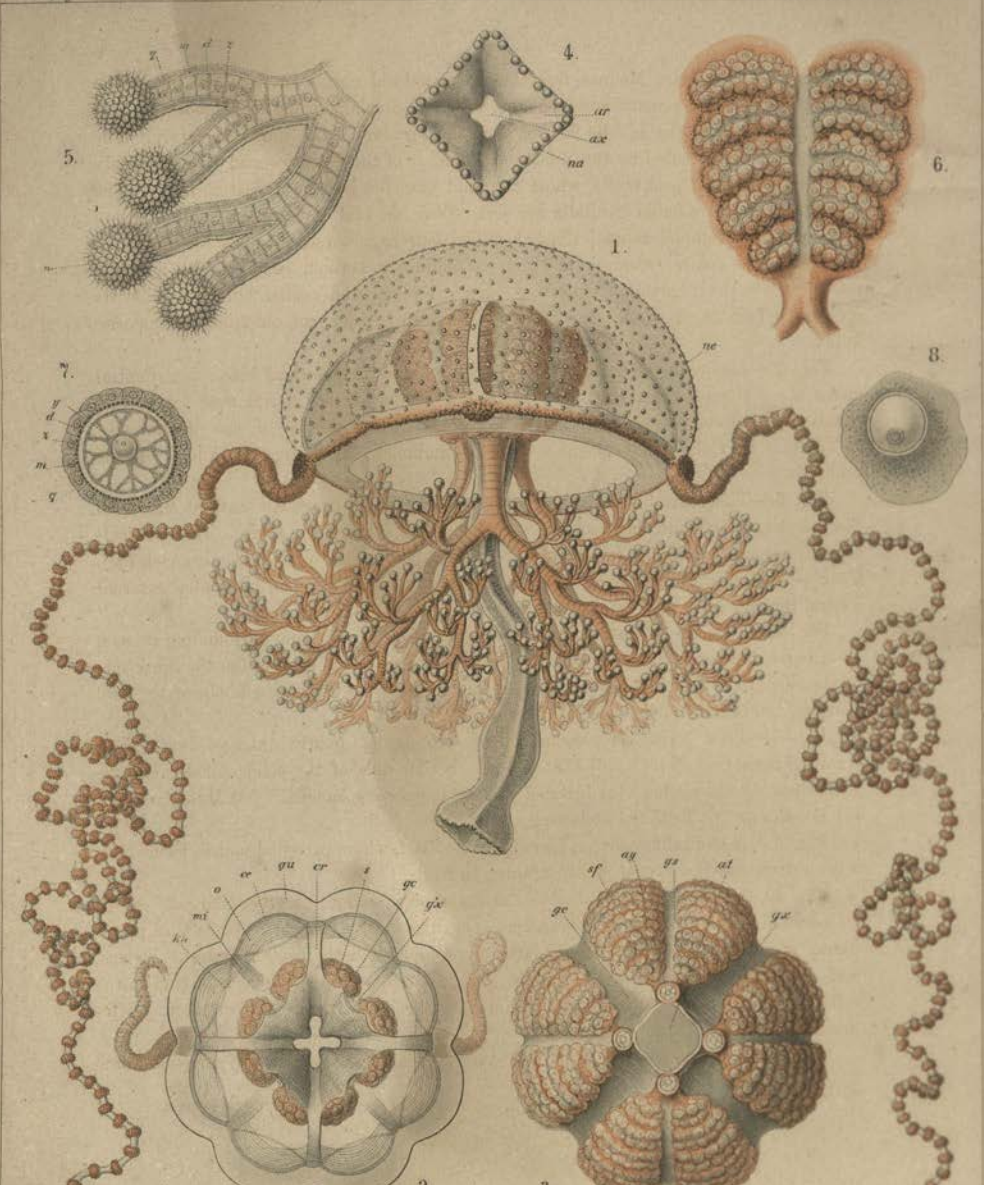
Fig. 4.—The oral opening and the lowest part of the œsophagus surrounding it, seen from below ten times the natural size. *ar* Four perradial oral grooves (on the inner side of the ribs of the œsophagus which project outwards). *ma* Urticating knobs of the oral margin. *ax* Axial hollow space of the œsophagus.

Fig. 5.—Four terminal branches of an oral style, greatly enlarged, with their terminal urticating knobs. (*d*) Coin-shaped chordal cells of the solid endodermal axis, with their central nuclei. (*z*) Internal plate or supporting lamella. (*m*) Muscular plate. (*y*) Ectoderm. *fn* Terminal urticating knob.

Fig. 6.—A genitalium shaped like a pinnated leaf, whose perradial midrib forms both a gastral rib and the gastral groove running in it.

Fig. 7.—Branch of an oral style in transverse section, greatly enlarged. *d* An endodermal chordal cell with its nucleus *y*, surrounded by branched filaments of protoplasm, which are united into a thin layer of protoplasm both inside round the nucleus, and outside on the inner wall of the cell. *z* The supporting lamella belonging to the cell. *m* Muscular plate (longitudinal muscular fibrillæ in transverse section). *q* Ectodermal epithelium.

Fig. 8.—A mature ovum, with large clear germinal vesicle and dark double-contoured germinal spot.



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THAMNOSTYLUS DINEMA.

PLATE II.

PTYCHOGENA PINNULATA.

Fig. 1.—The entire Medusa, twice the natural size, seen half from the side, half from below. The quadrangular œsophagus, which hangs from the middle of the umbrella cavity, is wide opened below. The four radial canals, whose pinnated proximal halves bear the genitalia, spring, with a conical enlargement, at the base of the œsophagus. The numerous tentacles at the umbrella margin are rolled together near their ends into delicate festoons.

Fig. 2.—The entire Medusa, twice the natural size, seen from below. Through the wide open central mouth, whose free margin (*al*) is irregularly lobed, we can look into the quadrangular cavity (*gc*) in whose quadratic fundus the rectangular cross of the central ciliated groove is visible (*gs*). Four conical funnels (*ch*) passing immediately into the four perradial canals (*cr*) run out from the four corners of the bottom of the stomach. The proximal part of the radial canals is occupied by the genitalia, whose pinnated leaves are delicately lobed beneath (*s*). *t* Tentacles. *ob* Marginal clubs. *v* Velum. *w* Subumbrella. *u* Umbrella.

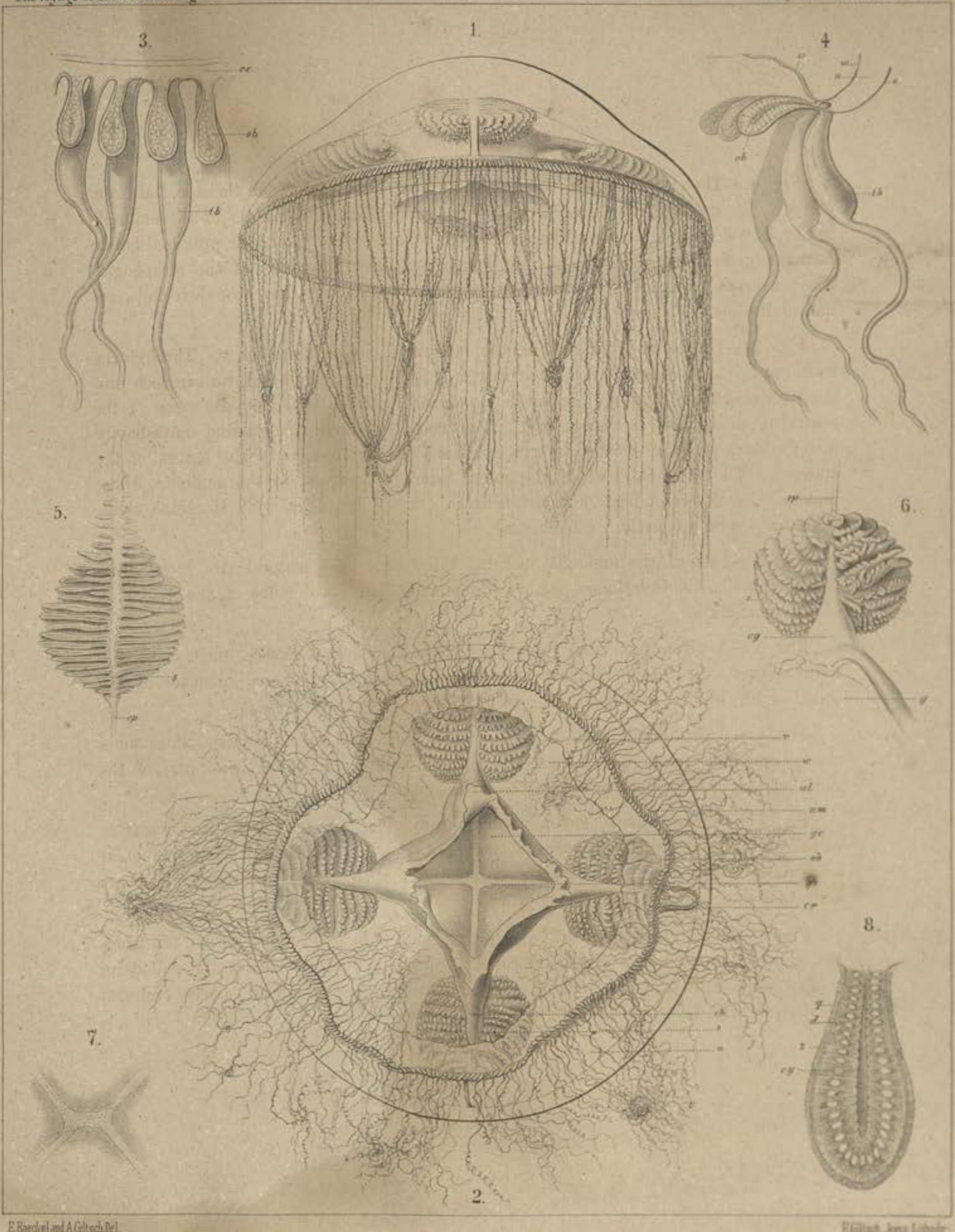
Fig. 3.—Part of the umbrella margin, three times the natural size. *v* Velum. *w* Subumbrella. *u* Gelatinous disc. *e* Exumbrella. *tb* Basal bulbs of the tentacles, *ob* Marginal clubs.

Fig. 5.—A genitalium, seen from above, from the umbral surface, three times the natural size. *cp* Peripheric part of the radial canal. *s* Pinnated branches of the radial canals, leading into the cavities of the reproductive leaves.

Fig. 6.—A genitalium, seen from below, from the subumbral surface, three times the natural size. *cp* Peripheric part of the radial canal. *ck* Conical basal part of the radial canal. *s* Reproductive leaf. *g* Gastral cavity.

Fig. 7.—Cruciate ciliated groove in the bottom of the stomach (on the gastral surface of the gelatinous umbrella, *u*), twice the natural size. It is amphithect here (not regular as in fig. 2). The four limbs of the cross, touch each other in pairs and the two pairs are connected like an H by a transverse-grove,

Fig. 8.—A marginal club (cordylis, olfactory club ?) in longitudinal section, ten times the natural size. *cy* Narrow central canal. *h* High cylindrical cells of the endoderm *q* Flat sense cells of the ectoderm. *z* Supporting plate or fulcral lamella (fultura) between the two layers of cells.



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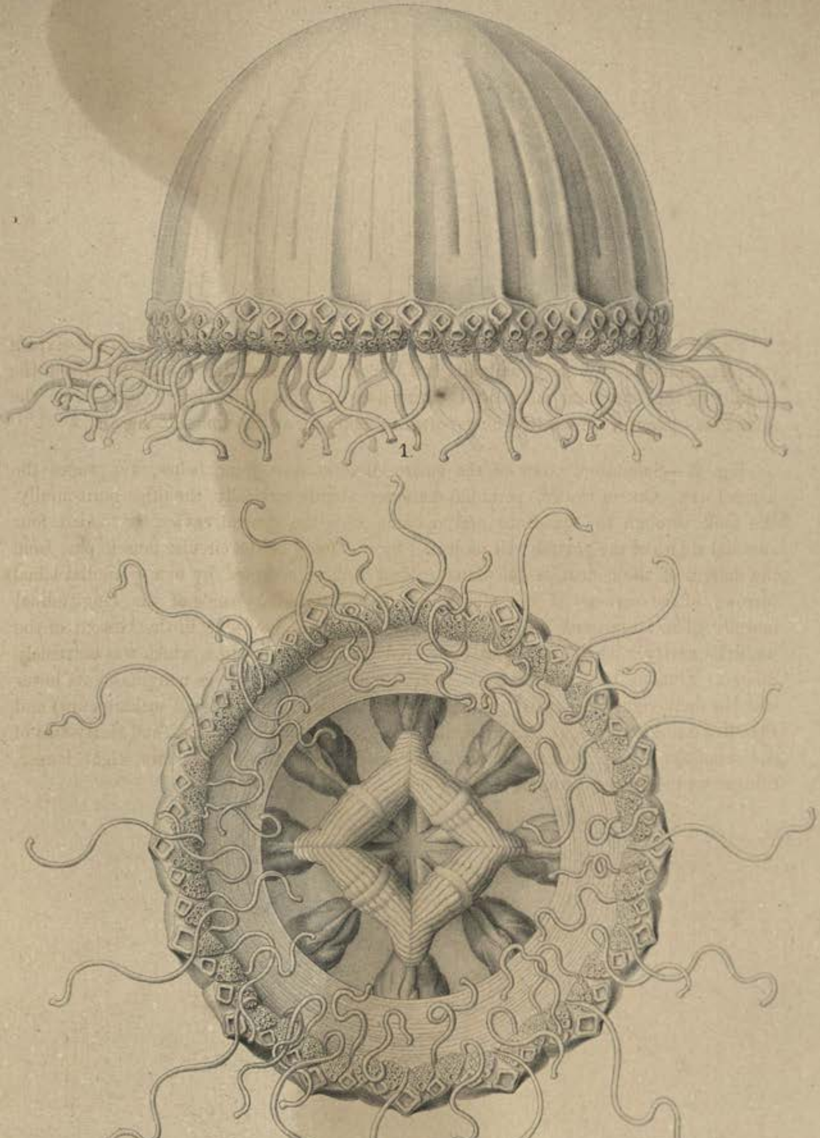
PTYCHOGENA PINNULATA.

PLATE III.

PECTYLLIS ARCTICA.

Fig. 1.—The entire Medusa in profile, five times the natural size. Both the sixteen complete radial ribs of the exumbrella and the sixteen alternating incomplete ribs in the middle of the exumbral intercostal depressions are both distinctly visible, also the numerous sucking-cups and the longer sucking tentacles at the umbrella margin.

Fig. 2.—Subumbral view of the entire Medusa seen from below, five times the natural size. One of the two perradial diameters stands vertically, the other horizontally. We look through the quadrate oral opening into the gastral cavity, in which four adradial ridges of the gastral wall project. Strong folds of the circular muscle pass from the margin of the mouth on the inner gastral wall, interrupted by four perradial labial furrows of the corners of the mouth and four interradial bands of the longitudinal muscle. The larger part, the eight folded genital sacs, is visible in the bottom of the umbrella cavity. Their distal part is covered by the broad velum, which was extremely dilated. Outside the velum we see sixteen lobes of the umbrella margin, on its lower side the forty-eight triangular sucking plates (composed of many small sucking-cups) and the alternating forty-eight larger sucking-cups (sixteen of the first size, and thirty-two of the second): inside, projecting from the insertion of the velum, forty-eight longer, thinner tentacles with terminal sucking-cups.



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PECTYLLIS ARCTICA.

PLATE IV.

PECTYLLIS ARCTICA.

Fig. 3.—Perradial section through the entire Medusa, five times the natural size. Strong longitudinal and transverse muscular folds are visible in the interior of the gastral cavity (*gp*), also eight gastral grooves (*gr*) between the eight adradial ridges of the gastral wall. The eight radial canals (*cr*) open above into the gastral cavity, by the gastral opening (*go*). Eight wide, folded genital sacs (*sc*) run out from the proximal halves of the radial canals, and are fastened to the subumbrella (*mw*) by the vertical leaf-shaped mesogoniæ (or genital mesenteries, *wr*). *ug* Gelatinous substance of the umbrella. *al* Oral lobes. *cc* Circular canal. *v* Velum. *vm* Freer margin of the velum.

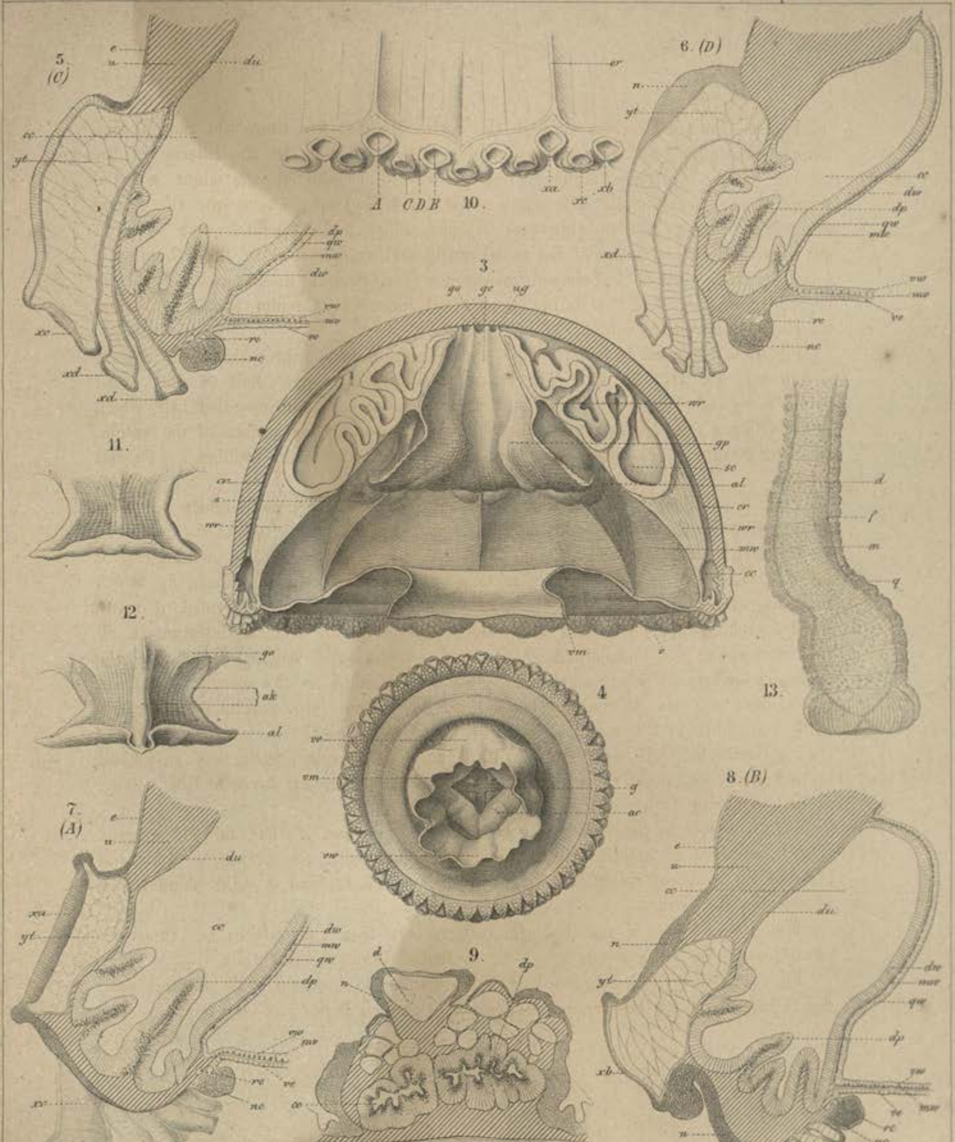
Fig. 4.—Subumbral view of the Medusa, seen from below, three times the natural size (comp. Pl. III. fig 2). The outer thick-walled abaxial half of the broad velum is separated by a deep circular furrow from the inner thin-walled half, which projects like a folded œsophagus. *vw* Subumbral, *ve* exumbral surface of the velum. *vm* Freer margin of the velum. *aw* Oral marginal with the lobial swelling. *g* Gastral cavity.

Figs. 5–8.—Four radial sections through the umbrella margin, slightly enlarged, in four directly following meridian planes, at the four points indicated in fig. 10 by the letters *ABCD*. The radial section in fig. 7 (*A*) touches a sucking-cup of the first size (*xa*), in fig. 8 (*B*) a sucking-cup of the second size (*xb*), in fig. 5 (*C*) a sucking-cup of the third size (*xc*), in fig. 6 (*D*) a sucking-cup formed of many smaller sucking-cups (*xd*). The following letters have the same signification in all the figures: *yt* the endodermal chordal axis of the solid sucking tentacle, *u* the gelatinous substance of the umbrella, *e* the exumbrella, *cc* the circular canal, *du* its umbral, *dw* its subumbral endodermal epithelium; *dp* glandular endodermal tufts and folds of the marginal wall of the circular canal, *mw* muscular layer of the subumbrella, *gw* ectodermal epithelium of the subumbrella, *vw* subumbral epithelium, *ve* exumbral epithelium of the velum; *mv* muscular layer of the velum; *nc* urticating ring, *rc* nerve ring.

Fig. 9.—Oblique tangential section through a portion of the umbrella margin, slightly enlarged, *cc* arching of the circular canal between the projecting folds and tufts of its marginal wall (*dp*); *n* urticating epithelium, and *d* solid chordal axis of several sucking-cups.

Fig. 10.—Portion of the umbrella margin, seen from the outside, ten times the natural size. Lettering, comp. figs. 5–8. *er* Radial rib of the exumbrella.

Figs. 11, 12.—The lower, free half of the œsophagus, three times the natural size; fig. 11 interradial, fig. 12 perradial section. *ak* Perradial angles. *al* Oral lobes.



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PECTYLLIS ARCTICA.

PLATE V.

PECTIS ANTARCTICA

Fig. 1.—The entire Medusa, seen in profile, three times the natural size. A deep exumbral coronal furrow separates the upper hemispheroidal half of the umbrella from the lower funnel-shaped half. In the former, only extremely numerous and very delicate radial exumbral ribs are visible, in the latter besides these, there are sixty-four deep radial furrows. On the umbrella margin, thirty-two groups of sucking-cups and tentacles, alternating with thirty-two larger isolated sucking-cups inserted higher up.

Fig. 2.—Perradial section through the whole Medusa, three times the natural size. A gelatinous cone (*uk*) projects downwards in the bottom of the gastral cavity from the apex of the gelatinous umbrella (*ug*). The eight conical adradial oral funnels (*io*) project inwardly in the oral part of the gastral cavity; between the funnels we see the fissure-shaped entrances into the eight pair of alternating buccal pouches (*bb*). The eight sac-shaped genitalia (*s*) contain wide genital pouches (*bs*). *mw* Subumbral circular muscles. *cr* Radial canals. *ce* Centripetal canals. *cc* Circular canals. *ts* Tentacles with sucking-cups.

Fig. 3.—The œsophagus, seen from the outside, six times the natural size. The eight radial canals (*cr*) which open above, pass into the gastral wall as longitudinal gastral grooves (*gs*) whose outer wall projects. *bb* Buccal pouches. *mo* Folds of the circular muscles of the quadrate oral margin. *al* Oral lobes.

Fig. 4.—The œsophagus in perradial longitudinal section, six times the natural size. Letters as in figs. 2 and 3. The conical gelatinous cone of the umbrella (*uk*) projects above into the gastral cavity. Below, alternating with the eight gastral grooves (*gs*) the eight adradial conical oral funnels (*io*) opening to the outside into the umbrella cavity, whilst a pair of buccal pouches (*bb*) open to the inside into the oral cavity below each oral funnel (comp. fig. 5).

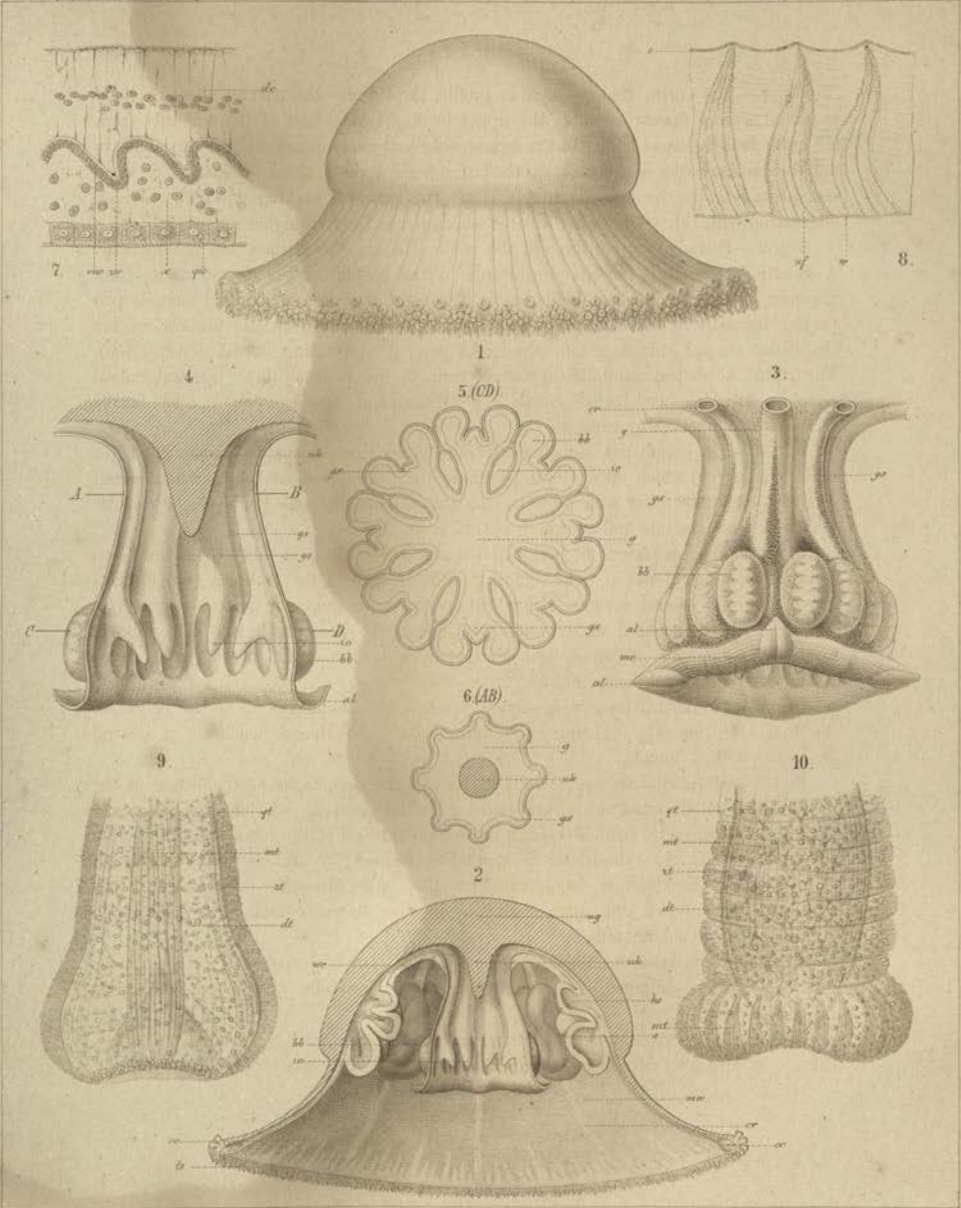
Fig. 5.—Horizontal transverse section through the œsophagus (*z*) at the height of the line *CD* (fig. 4), six times the natural size. *bb* Buccal pouches. *gs* Gastral grooves. *io* Oral funnels.

Fig. 6.—Horizontal transverse section through the œsophagus at the height of the line *AB* (fig. 4), six times the natural size. *g* Gastral grooves. *uk* Gelatinous cone.

Fig. 7.—Transverse section through the subumbral wall of the circular canal, greatly enlarged. *dc* Thick, cylindrical endodermal epithelium; a nucleus in the middle of each cell. *zw* Endodermal supporting lamella. *mw* Muscular folds of the subumbrella. *x* Plate of connective tissue below the muscular folds. *qw* Ectodermal epithelium of the subumbrella.

Fig. 8.—Transverse section through the thin peripheric part of the gelatinous umbrella, greatly enlarged. *e* Exumbrella. *w* Subumbrella. *uf* Bundle of elastic supporting fibres.

Figs. 9, 10.—Two tentacles with terminal sucking-cup, greatly enlarged. *qt* Ectoderm. *mt* Muscles. *zt* Supporting lamella. *dt* Endodermal axis.



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PECTIS ANTARCTICA

PLATE VI.

PECTIS ANTARCTICA.

Fig. 11.—Subumbral view of the entire Medusa (from below), three times the natural size; one of the two perradial diameters stands vertically, the other horizontally. We look through the wide quadrate oral opening into the gastral cavity, in which the eight conical white, adradial oral funnels project. The sixteen hemispheroidal buccal pouches are visible round the swollen oral margin; outside these, the eight wide genital sacs. In the peripheric part of the umbrella, the broad velum with its deep circular furrow is shown to the right, the circular muscular layer of the subumbrella and the cæcal centripetal canals (11–13 between each two radial canals) to the left (after removal of the velum). The umbrella margin shows the thirty-two groups of sucking-cups, to the left without the longer tentacles, to the right with the latter.

Fig. 12.—Radial section through the velum (*v*) and the marginal part of the umbrella with the circular canal (*cc*); slightly enlarged. *yc* Marginal fold in the circular canal. dc^1 Umbral, dc^2 subumbral endodermal epithelium of the circular canal. *mw* Muscular folds of the subumbrella (*w*). *qw* Ectodermal epithelium of the subumbrella. *uf* Elastic fibres in the gelatinous umbrella (*ug*). *e* Exumbrella. *ts* Tentacles with sucking-cups. *td* Tentacles without sucking-cups. *nc* Urticating ring. *rc* Nerve ring. *ve*, *vw*, *mw*, comp. fig. 13.

Fig. 13.—Radial section through the basal part of the velum, greatly enlarged. *vw* Subumbral or ventral epithelium. *x* Layer of vesicular connective tissue. *mv* Ramifications of the muscular plate. *zv* Supporting lamella. *ve* Exumbral or dorsal epithelium (comp. fig. 12).

Fig. 14.—Radial section through the deep circular fold of the velum, in the middle. Letters as in figs. 12 and 13. Greatly enlarged.

Fig. 15.—Longitudinal section through a tentacle with sucking cup, slightly enlarged. *qt* Ectodermal epithelium. *mt* Muscular plate. *zt* Supporting plate or fulcral lamella. *dt* Endodermal axis. *ng* Gelatinous substance of the umbrella margin. *uf* Elastic fibres of the gelatinous substance.

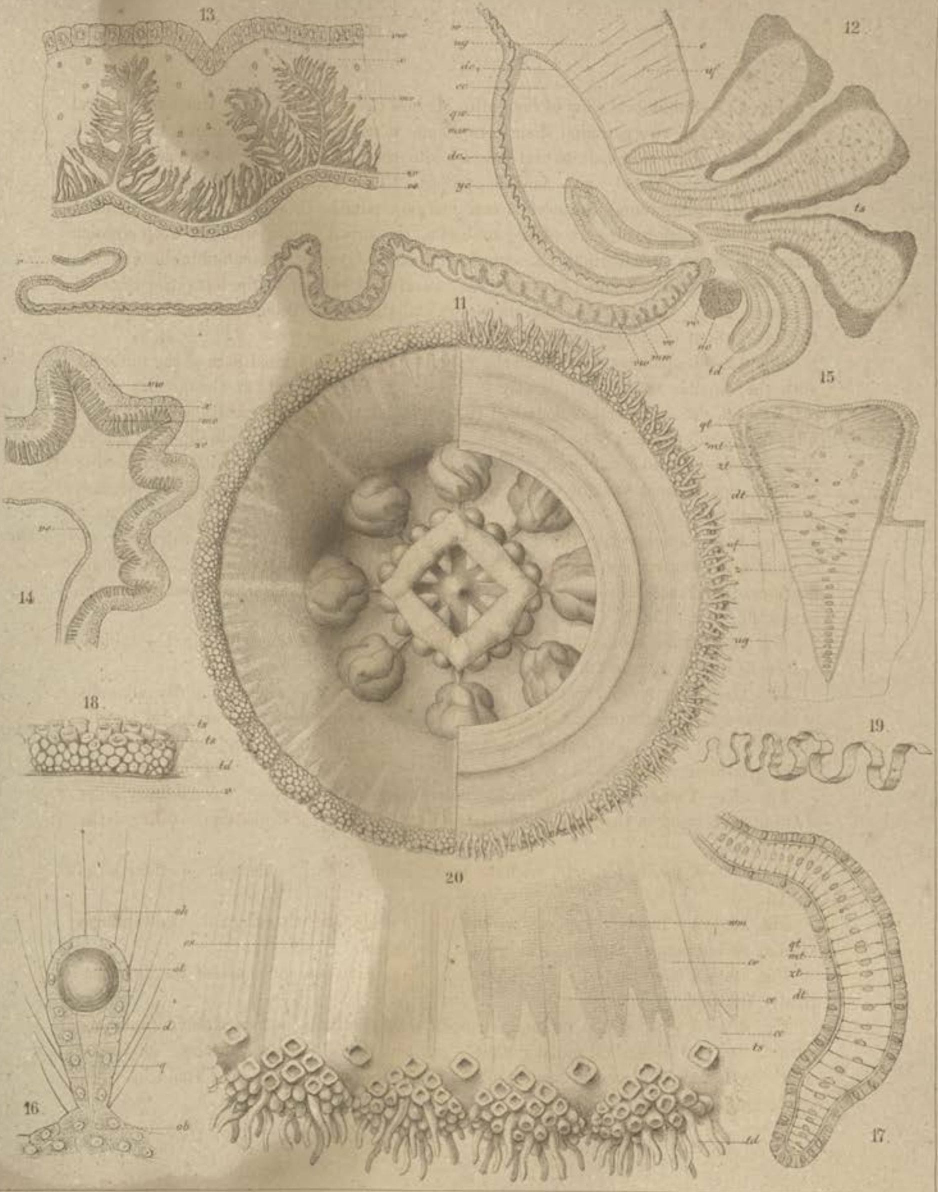
Fig. 16.—A sense club of the umbrella margin greatly enlarged. *oh* Auditory hairs. *ol* Otolite (enclosed in the last endodermal cell of the axis). *d* Endoderm. *q* Ectoderm. *ob* Sense pad.

Fig. 17.—A tactile tentacle, without sucking-cup, slightly enlarged. Letters as in fig. 15.

Fig. 18.—A tentacle group of the umbrella margin, slightly enlarged. *td* Tentacles without sucking-cups: *ts* with sucking-cups. *v* Velum.

Fig. 19.—A band-shaped elastic fibre from the gelatinous substance of the umbrella, greatly enlarged.

Fig. 20.—A piece of the umbrella margin seen from the outside, twelve times the natural size. *es* Exumbral radial furrow. *wm* Subumbral circular muscles. *cr* Radial canal. *ce* Centripetal canals. *cc* Circular canals. *ts* Sucking-cups. *td* Tentacles without sucking-cups.



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F. Giltsch, Jena. Lithogr.

PECTIS ANTARCTICA.

PLATE VII.

PECTANTHIS ASTEROIDES.

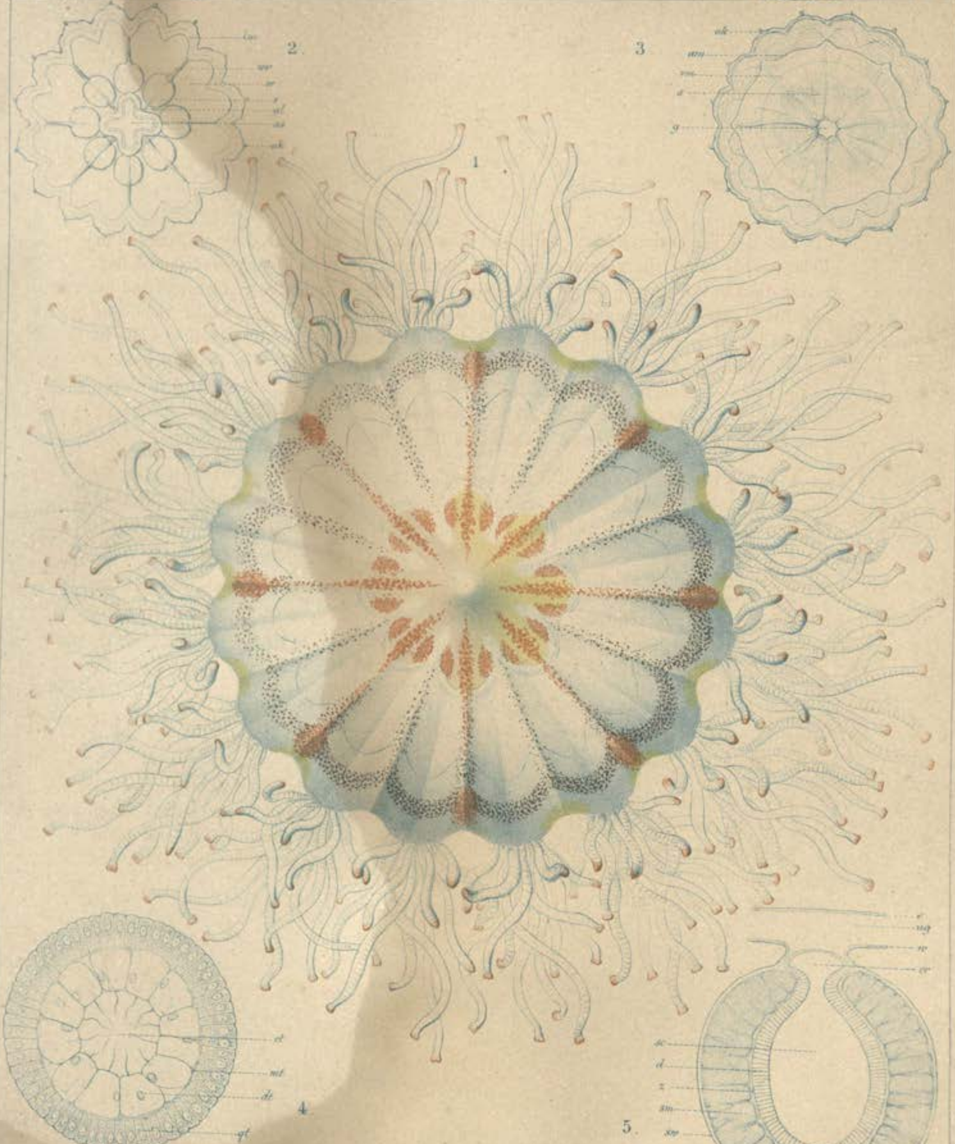
Fig. 1.—The entire Medusa, exumbral view (from above); painted by me from life in Pola, twenty times the natural size. The eight principal ribs (four perradial and four interradial) of the sixteen projecting radial ribs of the exumbrella are distinguished by blood-red pigment, accumulated, like an ocellus, at the distal end, whilst the eight adradial ribs, alternating with them only show the same black pigment (yellow white in reflected light) as the festoon-shaped urticating band of the exumbrella, running parallel to the umbrella margin. In the middle the golden-yellow base of the stomach with the surrounding corona of red genitalia shines through the umbrella. The numerous sucking tentacles are divided into sixteen bunches on the umbrella margin.

Fig. 2.—Umbrella (without tentacles) subumbral view (from below) with strongly contracted œsophagus ten times the natural size. The velum is omitted. *as* Oral cross. *al* Oral lobes. *s* Genitalia. *wr* Mesogonia. *w* Subumbrella. *lm* Marginal lobes. *ok* Auditory club.

Fig. 3.—Umbrella (without tentacles) subumbral view (from below) with widely extended œsophagus, ten times the natural size. *am* The octagonal margin of the flatly extended oral disc, through whose thin wall both the genitalia (*s*) and the free margin of the velum (*vm*) shines. *g* Central gastral cavity. *ok* Auditory club.

Fig. 4.—Transverse section through a hollow sucking tentacle (or "ambulacral foot") greatly enlarged. *qt* Ectoderm. *zt* Fulcral plate. *dt* Endoderm (flagellate cells). *ct* Axial canal of the tentacle.

Fig. 5.—Tangential transverse section through a genitalium, fifty times the natural size. *e* Exumbrella. *ug* Gelatinous umbrella. *w* Subumbrella. *cr* Radial canal. *sc* Reproductive pouch. *d* Endodermal epithelium of the pouch. *z* Fulcral plate. *sm* Spermarium. *sw* Subumbral ectodermal epithelium of the testis. *wr* Transverse section of the mesogonium.



E. Haeckel and A. Giltsch del.

PECTANTHIS ASTEROIDES

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PLATE VIII.

PECTANTHIS ASTEROIDES.

Fig. 6.—The entire Medusa in profile, ten times the natural size; crawling on the ground like an Echinoderm, with sucking tentacles, which partly adhered by suction like ambulacral feet, partly move about as if groping. (Drawn by me from life in Pola.)

Fig. 7.—The entire Medusa, in profile, ten times the natural size, anchored on its back. The long œsophagus, surrounded at the base by the corona of genitalia, projects and moves tentatively from the narrow opening of the strongly contracted velum. Tentacles as in fig. 10. (Drawn by me from life in Pola.)

Fig. 8.—A piece of the umbrella margin, greatly enlarged, seen from below and inside. *wn* Urticating knobs of the subumbrella. *wr* Distal end of the mesogonia. *g* Chordal ring of the endodermal cells, above the circular canals (?). *xp* Black pigmented, waved ring of cilia below the circular canal. *xo* Olfactory depression (?). *td* Tactile tentacles. *tc* Sucking tentacles. *ok* Auditory club.

Fig. 9.—Perradial section through the umbrella; the front half of the umbrella is removed leaving intact the central œsophagus with the corona of genitalia; thirty times the natural size. *u* Gelatinous substance of the umbrella. *wr* Mesogonia. *s* Spermarium. *mw* Muscular plate of the subumbrella. *wn* Urticating knobs of the subumbrella. *zt* Œsophagus. *al* Oral lobes. *y* Chordal ring on the subumbral wall of the circular canal (?) *xo* Sense body with ciliated depression (olfactory depression ?). *ok* Auditory club. Of the eight mesogonia (*wr*) three are cut away and five are preserved.

Fig. 10.—The entire Medusa in profile, twenty times the natural size. Whilst the sucking tentacles adhere below to the ground, the tactile tentacles are directed upwards and grope freely about. (Drawn by me from life in Pola.)

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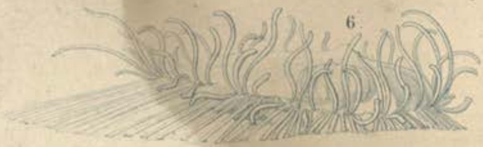

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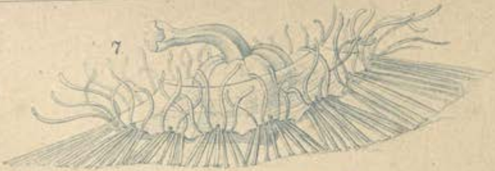

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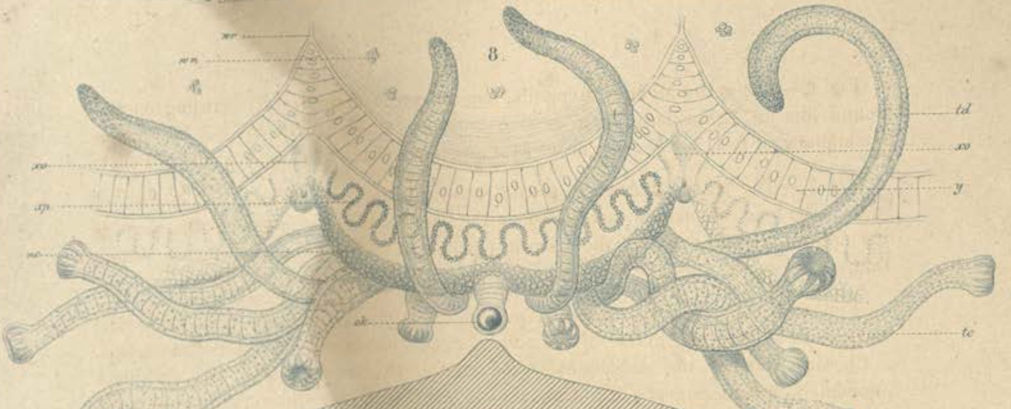

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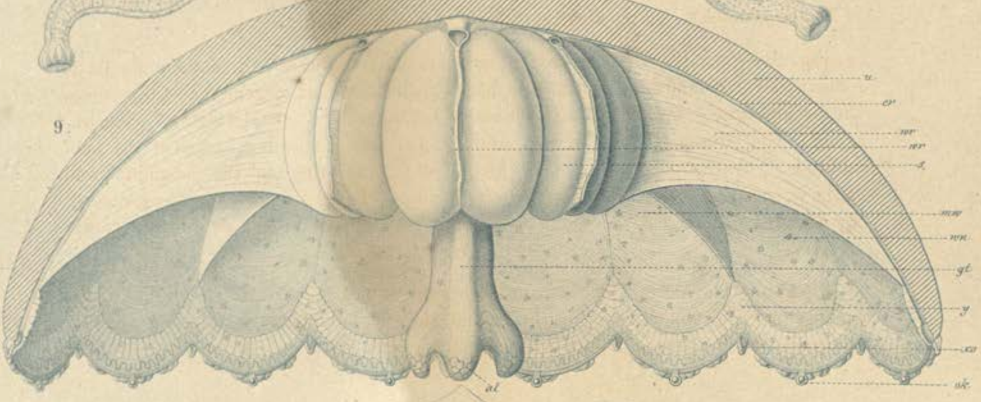

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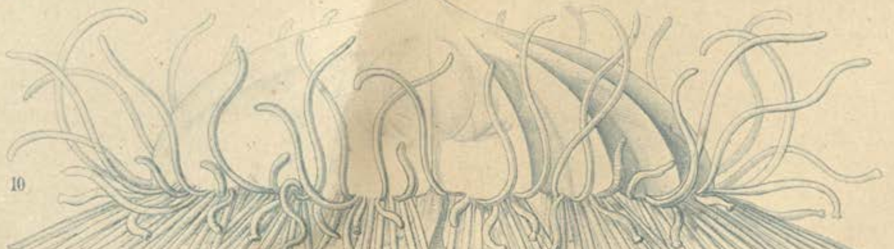

E. Haeckel and A. Giltsch Del.

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PECTANTHIS ASTEROIDES.

PLATE IX.

CUNARCHA ÆGINOIDES.

The meaning of the letters is the same throughout.

a	Oral opening.
bg	Perradial gastral pouches.
bl	Lobe pouches (ovaries).
ck	Peronial canals.
cm	Marginal canals.
d	Endoderm.
du	Umbral epithelium of the festoon canal.
dw	Subumbrella epithelium of the festoon canal.
cc	Coronal furrow of the exumbrella
en	Peronia or umbrella clasps.
er	Perradial ribs of the exumbrella.
es	Peronial furrow of the exumbrella.
gc	Central stomach.
gt	Œsophagus.
gu	Umbral wall of the central stomach.
gw	Subumbral wall of the central stomach.
h	Umbrella cavity.
hl	Cavities of the marginal lobes.
mp	Peronial muscle (perradial).
mv	Circular muscles of the velum.
mw	Circular muscles of the subumbrella.
n	Urticating organs.
nb	Urticating swelling at the base of the tentacle.
nc	Urticating ring of the umbrella margin.
oh	Auditory hairs (" setulæ acusticæ ").
ok	Auditory clubs (cordyli).
ok,	Larger perradial auditory clubs.
ok,,	Smaller adradial clubs.
ol	Otolites.
oo	Otoporpæ.
op	Auditory pad in the peduncle of the auditory club.
q	Ectoderm.
qe	Ectoderm of the exumbrella.
qw	Ectoderm of the subumbrella.
r	Nerves.
rc,	Dorsal nerve ring.
rc,,	Ventral nerve ring.
s	Ovaries.
so	Egg cells.
t	Tentacles.
tr	Tentacle root.
u	Umbrella.
uf	Elastic fibres of the umbrella.
ug	Gelatinous substance of the umbrella.
v	Velum.
ve	Exumbral epithelium of the velum.
vw	Subumbral epithelium of the velum.
z	Supporting (fulcrum).
zv	Supporting plate of the velum.
zw	Supporting plate of the subumbrella.

Fig. 1. Ventral view of the entire Medusa (from below), with folded collar lobes and tentacles, fifteen times the natural size.

Fig. 2. Dorsal view of the entire Medusæ, with collar lobes extended flatly, ten times the natural size.

Fig. 3. Profile view of the entire Medusa, with stiffly extended collar lobes and extended œsophagus, fifteen times the natural size.

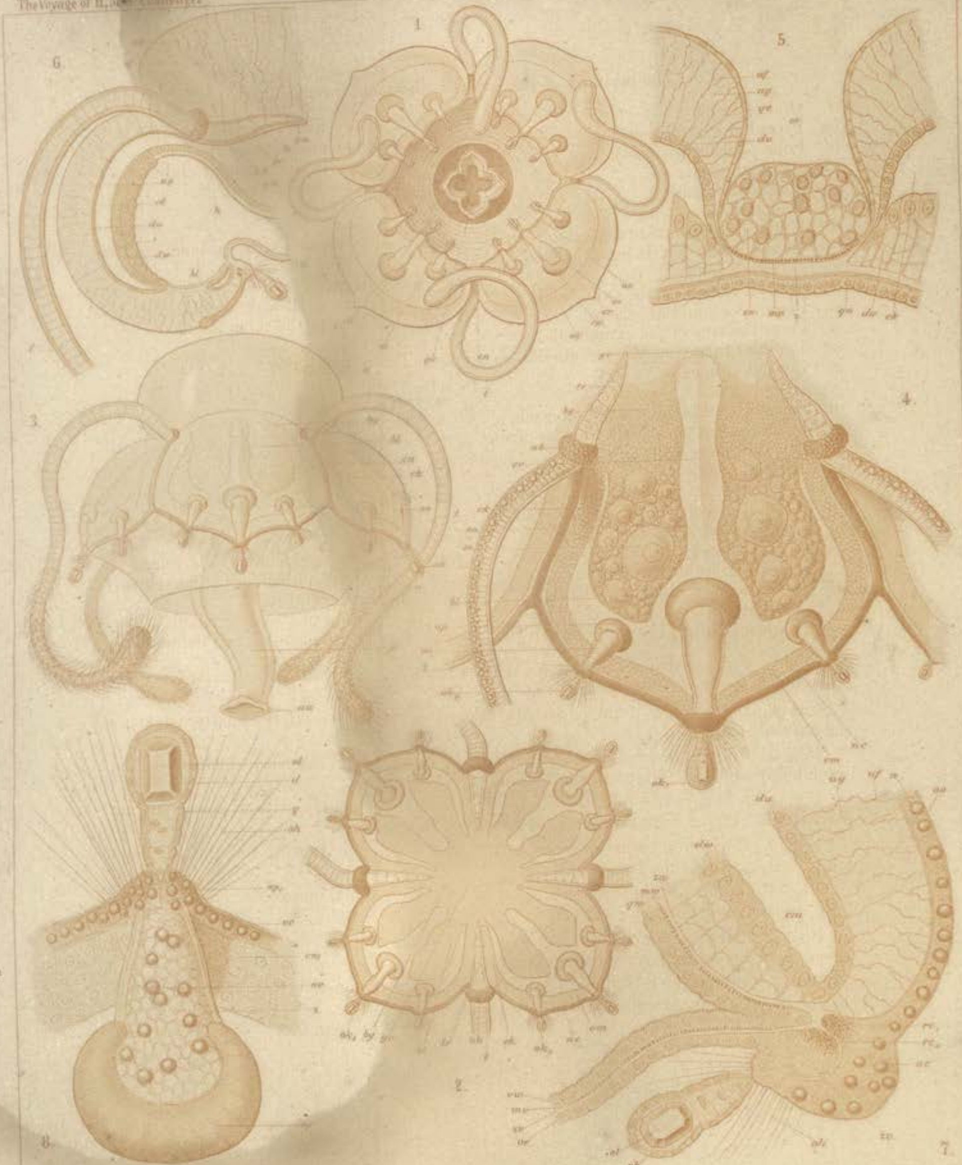
Fig. 4. A collar lobe (or a quadrant of the umbrella collar), with the surrounding parts, flatly extended, thirty times the natural size.

Fig. 5. Horizontal transverse section through a peronial furrow, and the peronium lying in it, greatly enlarged.

Fig. 6. Radial section through a quadrant of the umbrella, projected semi-diagramatically, twenty-five times the natural size.

Fig. 7. Radial section through the umbrella margin and the auditory club with peronium lying on it, greatly enlarged.

Fig. 8. An auditory club, with the peronium belonging to it, and the surrounding part of the umbrella margin, greatly enlarged.



E. Haeckel ad Natur. del.

E. Giltsch, Jena, Lithogr.

CUNARCHA AEGINOIDES.

PLATE X.

POLYCOLPA FORSKALII.

Fig. 1.—Ventral view of the entire Medusa (from below), four times the natural size. *gc* Central part of the flat gastral cavity. *am* Oral margin, swollen and thickened. *gw* Subumbral wall of the central gastral cavity. *sf* Ring-shaped genitalium (ovary). *h* Umbrella cavity (peripheric part). *v* Velum. *l* Collar lobes. *ok* Auditory clubs. *t* Tentacles.

Fig. 2.—Profile view of the entire Medusa (from the side), three times the natural size, drawn from life. The central gelatinous umbrella lens touches the expanse of water and the knee of the genuflected tentacles with its vaulted arch. The tentacles are inserted in the circular coronal furrow, which separates the central umbrella lens from the peripheric umbrella collar and alternates with the twenty-five collar lobes of the latter.

Fig. 3.—Radial section through the umbrella, six times the natural size. *ug* Gelatinous lens of the umbrella. *ec* Coronal furrow of the exumbrella. *t* Tentacle. *tr* Tentacle root. *l* Collar lobes. *hl* Cavities of the collar lobes. *oo* Peronium. *ok* Auditory club. *cf* Festoon canal. *nc* Urticating ring. *v* Velum. *sf* Ovary. *gc* Central stomach. *at* Œsophagus. *am* Margin of the mouth. *h* Umbrella cavity.

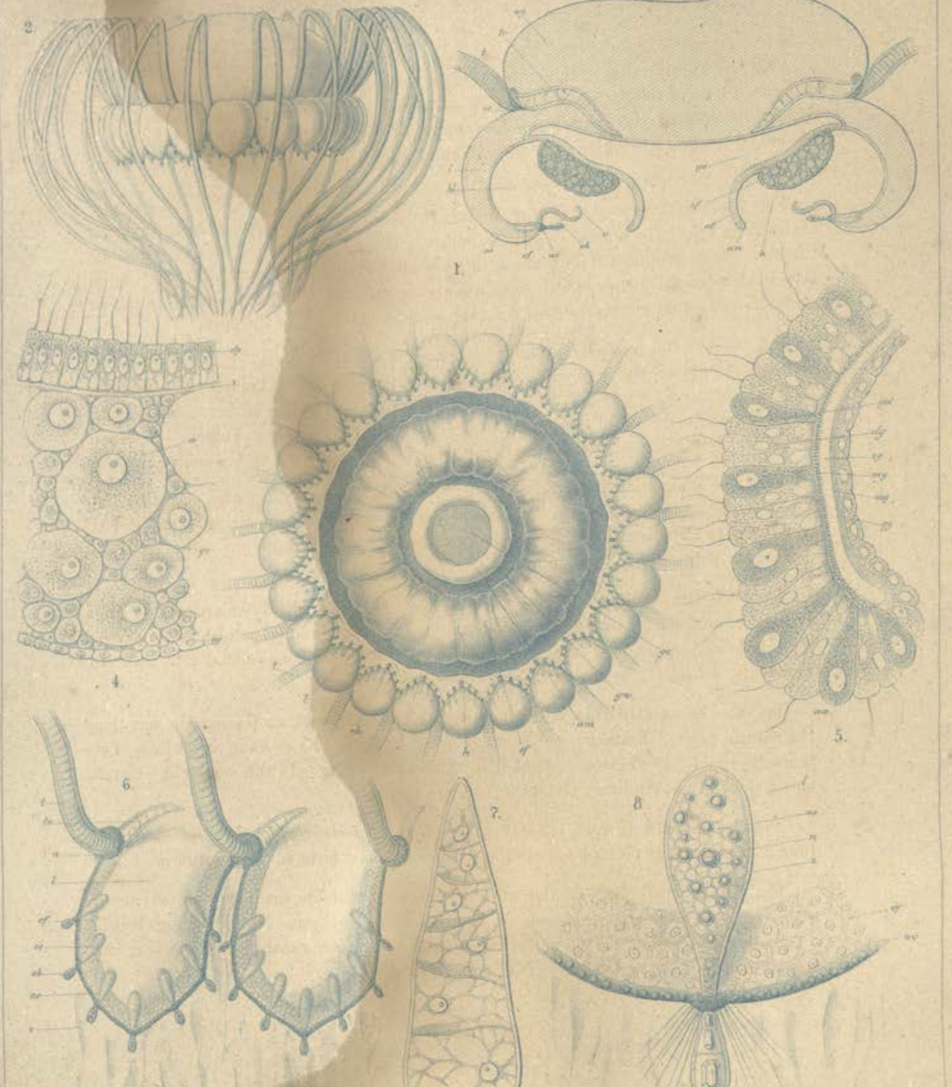
Fig. 4.—Tangential transverse section through the ovary, greatly enlarged. *dg* Endodermal epithelium of the subumbral gastral wall. *z* Supporting plate (fulcral lamella). *qs* Ectodermal germinal cells (young ova). *so* Mature ova cells. *qg* Ectodermal epithelium of the subumbrella.

Fig. 5.—Longitudinal section through the œsophagus, greatly enlarged. *dg* High cylindrical epithelial cells of the endoderm. *gd* Flask-shaped glandular cells between the epithelial cells. *zg* Thick supporting lamella. *mg*, Longitudinal muscles. *mg*, Transverse muscles. *qg* Flat epithelial cells of the ectoderm.

Fig. 6.—Two collar lobes, with the surrounding parts seen from the outside, ten times the natural size. *t* Tentacles. *tr* Tentacle roots. *n* Urticating swelling at the bars of the tentacle roots. *cf* Festoon canal. *nc* Urticating ring of the umbrella margin. *oo* Otoporpæ. *ok* Auditory clubs. *v* Velum.

Fig. 7.—A tentacle root, greatly enlarged and foreshortened. We see clearly the branched streams of protoplasm running from its nuclear layer to its mural layer.

Fig. 8.—A small piece of the umbrella margin, with an auditory club (*oh*) and its otoporpæ (*oo*); greatly enlarged. *n* Spheroidal nematocysts. *z* Supporting lamella. *l* Gelatinous substance of the umbrella collar. *cf* Festoon canal. *nc* Urticating ring. *oh* Auditory hairs. *ot* Otolites. *v* Velum.



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A. Giltsch, Jena Lithogr.

POLYCULPA FORSKALII.

PLATE XI.

PEGANTHA PANTHEON.

Fig. 1.—The entire Medusa, seen from the side and somewhat from below, four times the natural size. The eighteen tentacles are retroverted upwards. The lobes of the umbrella collar are delicately bordered with otoporpæ and auditory clubs, below which the velum projects freely.

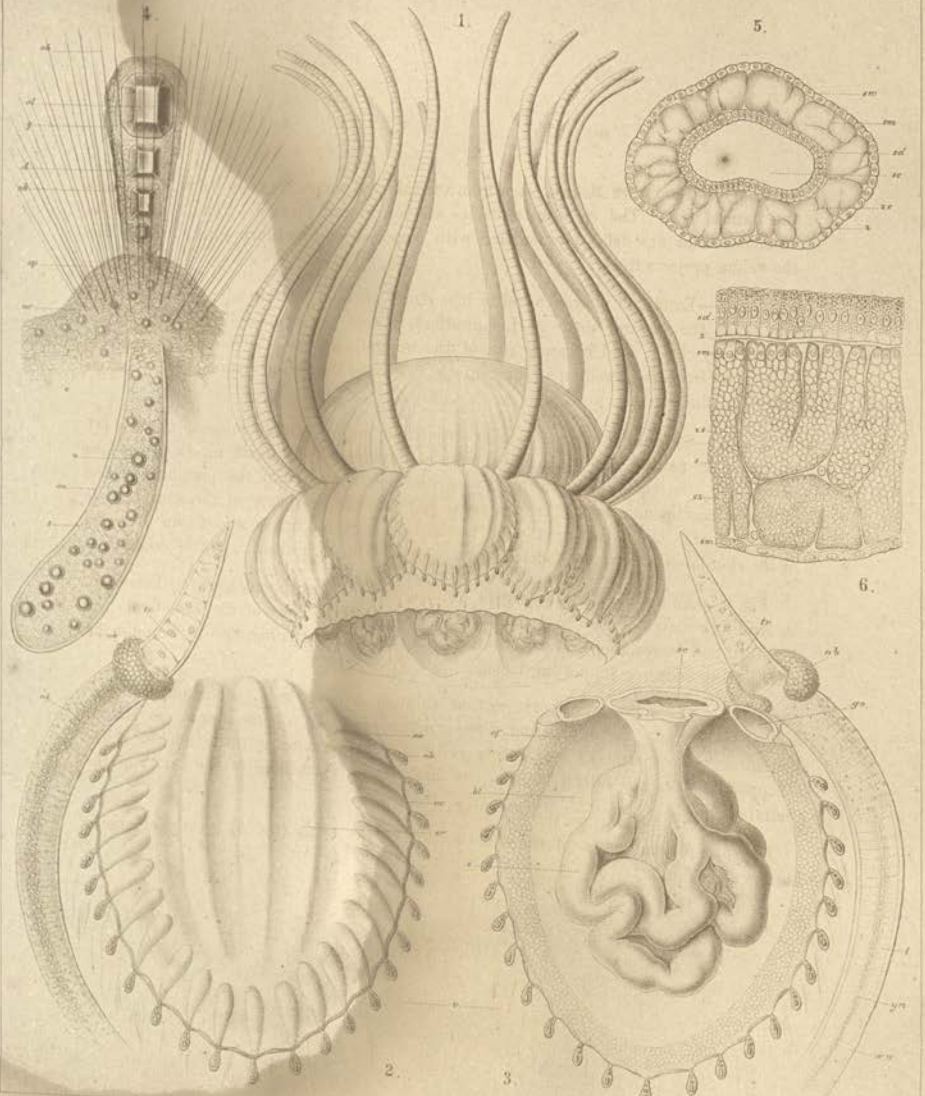
Fig. 2.—Exumbral view of a collar lobe (from outside) with an adjacent tentacle (*t*) ten times the natural size. *er* Longitudinal ribs of the exumbrella. *oo* Otoporpæ. *ok* Auditory club. *nc* Urticating ring of the umbrella margin. *v* Velum. *tr* Tentacle root. *nb* Urticating swelling at the tentacle base. *nt* Urticating streaks on the abaxial surface of the tentacle.

Fig. 3.—Subumbral view of a collar lobe (from inside) with an adjacent tentacle (*t*), ten times the natural size. The folded testis sac (*s*) hangs freely in the middle in the lobe cavity (*hl*). *sc* Opening of the cavity of the spermarium into the periphery of the stomach. *go* opening of the festoon canal (*cf*) into the periphery of the stomach. *tr* Tentacle root. *nb* Urticating swelling at the base of the tentacle. *yn* Chain of nuclei of the chordal cells of the endodermal axis. *xn* Urticating epithelium of the ectoderm.

Fig. 4.—An auditory club (*ok*) with its otoporpa (*oo*) greatly enlarged. *q* Ectoderm. *oh* Auditory hair of the ectoderm. *d* Endoderm. *ol* Otolites of the endoderm. *op* Auditory pad (sense knob). *nc* Urticating ring of the umbrella margin. *e* Exumbrella. *n* Urticating cells. *z* Supporting lamella.

Fig. 5.—Horizontal transverse section through a testis sac. *su* Subumbral ectodermal epithelium. *zs* Supporting fibres containing nuclei, of the testis. *sz* Mature spermatozoa (zoospermia). *sm* Mother cells of the spermatozoa (male nuclear cells). *z* Supporting plate or fulcral lamella. *sd* Endodermal epithelium of the cavity of the genital sac (*sc*).

Fig. 6.—A small piece of the same section of the testis (fig. 5) greatly enlarged. Letters as in fig. 5.



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PEGANTHA PANTHEON.

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PLATE XII.

PEGANTHA PANTHEON.

Fig. 7.—Radial section through the entire Medusa five times the natural size (semidiagramatic). *ug* The solid gelatinous umbrella lens. *t* Tentacles. *tr* Tentacle roots. *ec* Horizontal coronal furrow of the umbrella. *lm* Gelatinous collar lobes. *oo* Otoporpæ. *v* Velum. *cf* Festoon canal. *sm* Testes. *sc* Gastral cavity of the testis. *yc* Central gastral cavity. *ga* Œsophagus. *a* Oral opening. *dg* Endoderm of the subumbral gastral wall. *qg* Ectodern of the subumbral gastral wall.

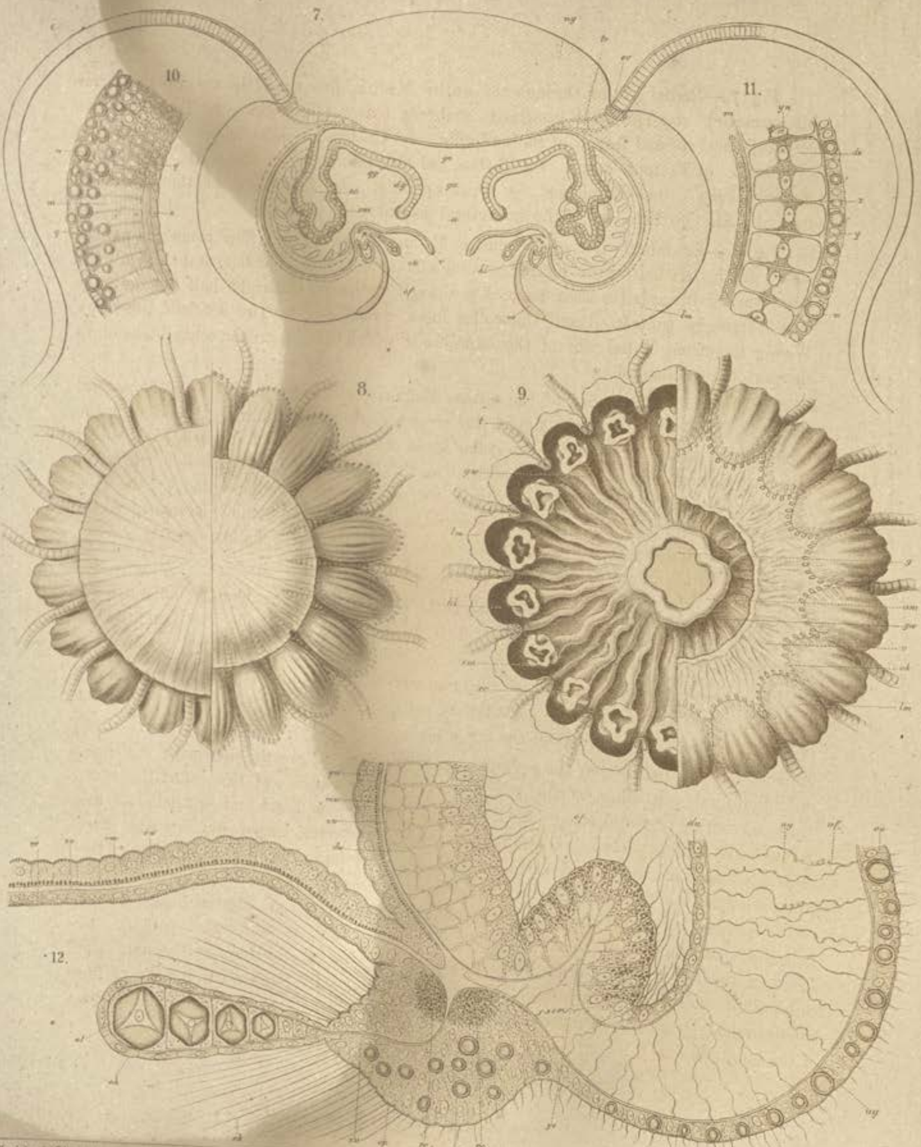
Fig. 8.—Exumbral view of the entire Medusa (from below), four times the natural size. In the left half of the figure the umbrella lens is spead out flat, and the umbrella lobes turned inwards (in their natural position), whilst in the right half the umbrella lens is strongly contracted and the collar lobes spread out flat (by artificial pressure). We see the strong radial ribs of the exumbrella which pass from the central lens on to the peripheric collar lobes.

Fig. 9.—Subumbral view of the entire Medusa (from below), four times the natural size. In the right half of the figure the greater part of the umbrella is hidden by the broad folded velum (*v*) and by the collar lobes which are turned inwards (*lm*), whilst these are removed by a horizontal section in the left half. By this section the testes (*sm*) are halved and their cavity opened; we see how they lie protected by the lobe cavities (*hl*) and run out from the peripheric walls of the shallow stomach whose subumbral wall (*gw*) is laid in deep folds. *g* Bottom of the shallow gastral cavity. *am* Margin of the mouth.

Fig. 10.—A portion of the distal part of a tentacle, moderately enlarged. *q* Ectoderm cells. *n* Spheroidal nematocysts of the ectoderm cells. *m* Longitudinal muscular fibres. *z* Supporting plate.

Fig. 11.—A similar portion of the tentacle in longitudinal section, moderately enlarged. Letters as in fig. 10. *dz* Chordal cells of the endoderm. *yn* Central nuclei of the chordal cells (in the axis of the tentacle).

Fig. 12.—Radial section through the umbrella margin, greatly enlarged. *v* Velum. *vu* Subumbral epithelium of the velum. *mv* Circular muscles of the velum (in transverse section). *zv* Supporting lamella of the velum. *ve* Exumbral epithelial of the velum. *ok* Auditory club. *ol* Otolites (in which a nucleus, tinged red, is visible after treatment with acetic acid and carmine). *oh* Auditory hairs. *nc* Urticating ring of the umbrella margin. *rc'* Dorsal nerve ring (in transverse section). *rc"* Ventral nerve ring. *oo* Otoporpa. *ug* Gelatinous substance of the umbrella. *uf* Elastic fibres in the gelatinous substance. *cf* Distal part of the festoon canal (in transverse section). *yc* Lobe on the lower margin of the festoon canal. *du* Umbral endoderm epithelium. *dw* Subumbral endoderm epithelium of the festoon canal. *zw* Supporting lamella of the subumbrella. *mw* Circular muscular layer of the subumbrella. *qw* Ectoderm epithelium of the subumbrella.



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PEGANTHA PANTHEON.

E. Giltsch, Jena. Lithogr.

PLATE XIII.

ÆGINURA MYOSURA.

Fig. 1.—The entire Medusa in profile, twice the natural size. *ug* Gelatinous substance of the umbrella. *t* Tentacles. *en* Peronia. *ck* Peronial canals. *cm* Marginal canal. *nc* Urticating ring of the umbrella margin. *bs* Internemal genital pouches (lobe pouches). *ok* Auditory clubs. *z* Supporting plate. *v* Velum (hanging loose).

Fig. 2.—The entire Medusa seen from below with strongly contracted umbrella margin, three times the natural size. Letters as in fig. 1. The four-lobed oral opening (*aw*) is visible below in the middle. *w* Subumbrella.

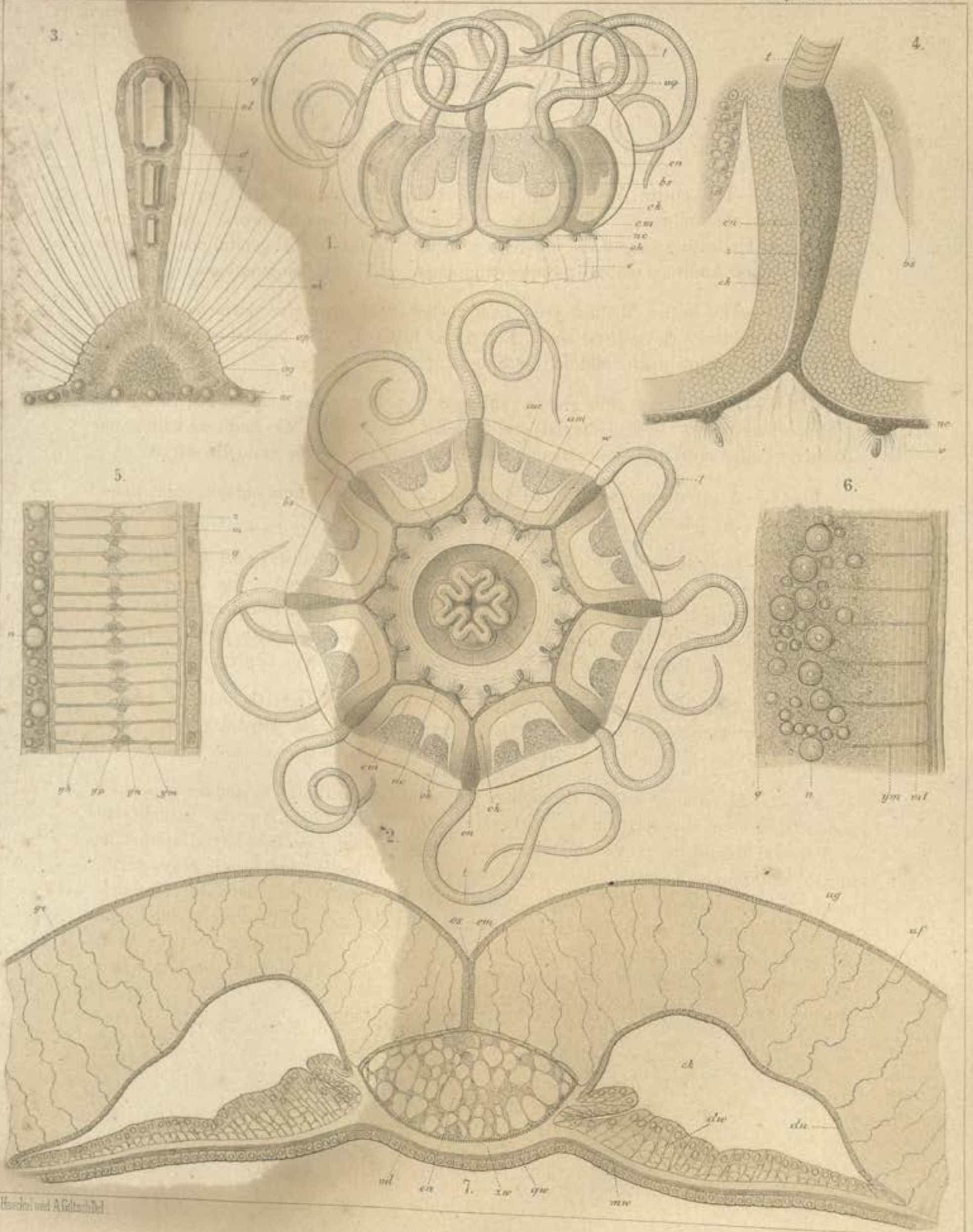
Fig. 3.—An auditory club greatly enlarged. *q* Flat sense cells of the ectoderm. *z* Supporting plate. *d* Endodermal otolite cells. *ol* Otolite. *oh* Auditory hairs. *op* Auditory pad. *og* Ganglion acusticum. *nc* Urticating ring of the umbrella margin.

Fig. 4.—A peronium (*en*) with the surrounding parts, seen from outside, eight times the natural size. Letters as in fig. 1.

Fig. 5.—Longitudinal section through a portion of the distal part of a tentacle greatly enlarged. *q* Ectodermal epithelium; *h* its nematocysts. *m* Longitudinal muscles. *z* Supporting plates. *y* Coin-shaped discoid cells of the endodermal axis. *ym* Thick membranes of the axis. *yh* Cavity of the axis filled with clear gelatinous substance (?). *yp* Protoplasmic cord in the axis of the cavity. *yn* Central cell nucleus.

Fig. 6.—A portion of the distal part of a tentacle seen from the outside, greatly enlarged. *q* Ectodermal epithelium; *n* its nematocysts. *mt* Muscular plate (with longitudinal fibres). *ym* Septa of the chordal cells of the endodermal axis.

Fig. 7.—Horizontal section through a peronium (*en*), with the two adjacent peronial canals (*ck*), and the surrounding parts of the umbrella, 120 times the natural size. *es* Peronial furrow of the exumbrella. *em* Peronial plate. *qe* Ectodermal epithelium of the exumbrella. *ug* Gelatinous substance of the umbrella. *uf* Elastic fibres of the gelatinous substance. *ck* Peronial canals. *du* Flat umbral endodermal epithelium; *dw* high subumbral epithelium of the peronial canals. *en* Urticating skeletal cells of the peronium. *ml* Peronial muscle (longitudinal fibres). *g* Supporting plate of the subumbrella. *mw* Circular muscular layer of the subumbrella. *qw* Ectodermal epithelium of the subumbrella (comp. Pl. XIV. fig. 12).



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AEGINURA MYOSURA.

E. Giltsch, Jena, Lithogr.

PLATE XIV.

ÆGINURA MYOSURA.

Fig. 8.—View of the œsophagus from below, six times the natural size. *ar* Interradial furrows of the œsophagus. *al* Perradial bordering oral lobes. *gw* Subumbral gastral wall.

Fig. 9.—Isolated sense cells from the dorsal nerve ring, in connection with two multipolar ganglion cells, about 1000 times the natural size.

Fig. 10.—Ganglion cells and nerve fibres from the auditory ganglion (fig. 3, *og*), about 1000 times the natural size.

Fig. 11.—The entire Medusa halved by a perradial meridian section, five times the natural size. *ug* Gelatinous substance of the umbrella. *e* Exumbrella. *ec* Coronal furrow of the exumbrella. *en* Peronia. *em* Peronial plates. *nc* Urticating ring of the umbrella margin. *ok* Auditory clubs. *v* Velum. *w* Subumbrella. *mw* Circular muscle of the subumbrella. *h* Umbrella cavity. *tr* Tentacle roots. *t* Tentacles. *cm* Marginal canal. *ck* Peronial canals. *bs* Internemal gastral pouches (testes). *gc* Central stomach: *gu* its umbral wall (cover of the stomach); *gw* its subumbral wall (bottom of the stomach). *at* Œsophagus. *al* Oral lobes.

Fig. 12.—Horizontal transverse section through a peronium and the adjacent parts of the umbrella, 400 times the natural size. *qw* Ectodermal epithelium of the subumbrella: *mw* its muscular layer; *zw* its supporting plate. *ck* Lumen of the peronial canals (in transverse section): *dw* high vacuolised cylindrical epithelium of their subumbral endoderm; *du* flat, small dice-epithelium of their umbral endoderm. *ug* Gelatinous substance of the umbrella. *uf* Elastic fibres of the gelatinous substance. *en* Urticating skeletal tissues of the peronium (the urticating thread, whose spiral windings have the appearance of fine transverse streaks, has fallen out of many of the transected thick-walled nematocysts). *ml* Longitudinal muscular fibres on the axial side of the peronium, in transverse section. *zp* Supporting lamella of the peronium. *en* Peronial plate (embedded double lamella of the ectodermal epithelium, comp. Pl. XIII. fig. 7).

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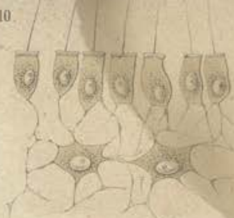

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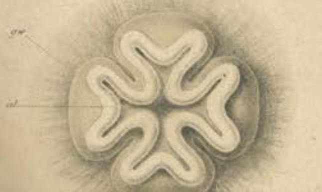

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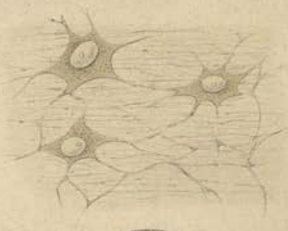

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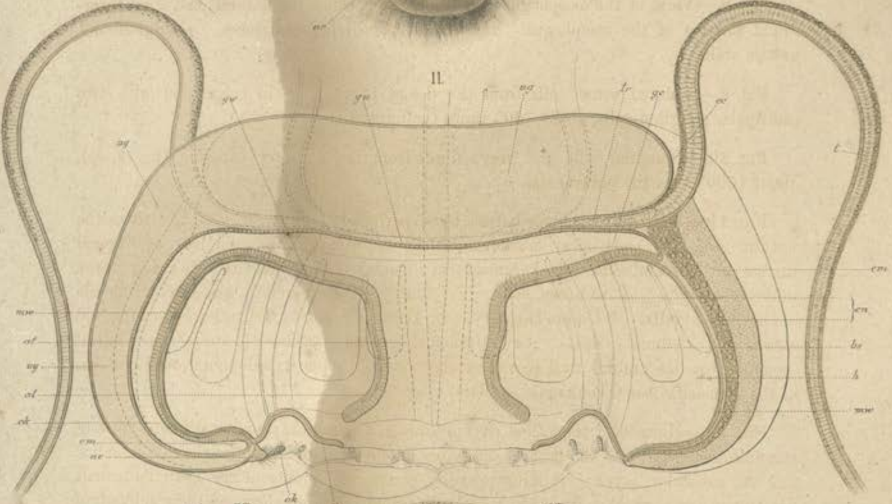

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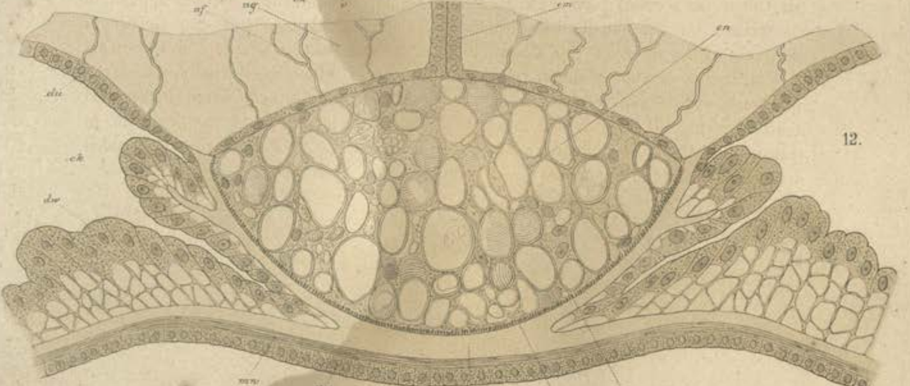

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AEGINURA MYOSURA.

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PLATE XV.

TESSERANTHA CONNECTENS

The meaning of the letters is the same throughout.

a	Oral opening.
ak	Buccal ribs (perradial).
al	Oral lobes (perradial).
ar	Oral grooves (interradial).
bp	Gastral pouches (perradial).
cs	Coronal sinus.
er	Exumbral urticating ribs.
er'	Eight larger principal urticating ribs.
er"	Eight smaller adradial urticating ribs.
f	Gastral filaments.
ft	Tæniola.
ga	Oral stomach (œsophagus).
gb	Basal stomach (apical canal).
gc	Central stomach (principal cavity).
gn	Grooves of the basal stomach (perradial).
go	Gastral openings (perradial).
gp	Palatine opening (porta palatina).
gy	Pyloric opening (porta pylorica).
hc	Cavity of the umbrella corona (autrum coronæ).
ii	Funnel cavities (interradial).
kn	Septal nodes (cathamma).
l	Marginal lobes.
mb	Buccal muscles.
mc	Coronal muscle.
md'	Perradial deltoid muscle.
md"	Interradial deltoid muscle.
oc	Ocelli (pigment eyes).
p	Apical process (umbrella peduncle).
s	Genitalia (or reproductive glands).
ta	Adradial tentacles.
ti	Interradial tentacles.
tp	Perradial tentacles.
ug	Gelatinous substance of the umbrella.
uw	Subumbrella.
wr	Mesenteries (mesogonia, perradial).
z	Supporting plate (fulcral lamella).

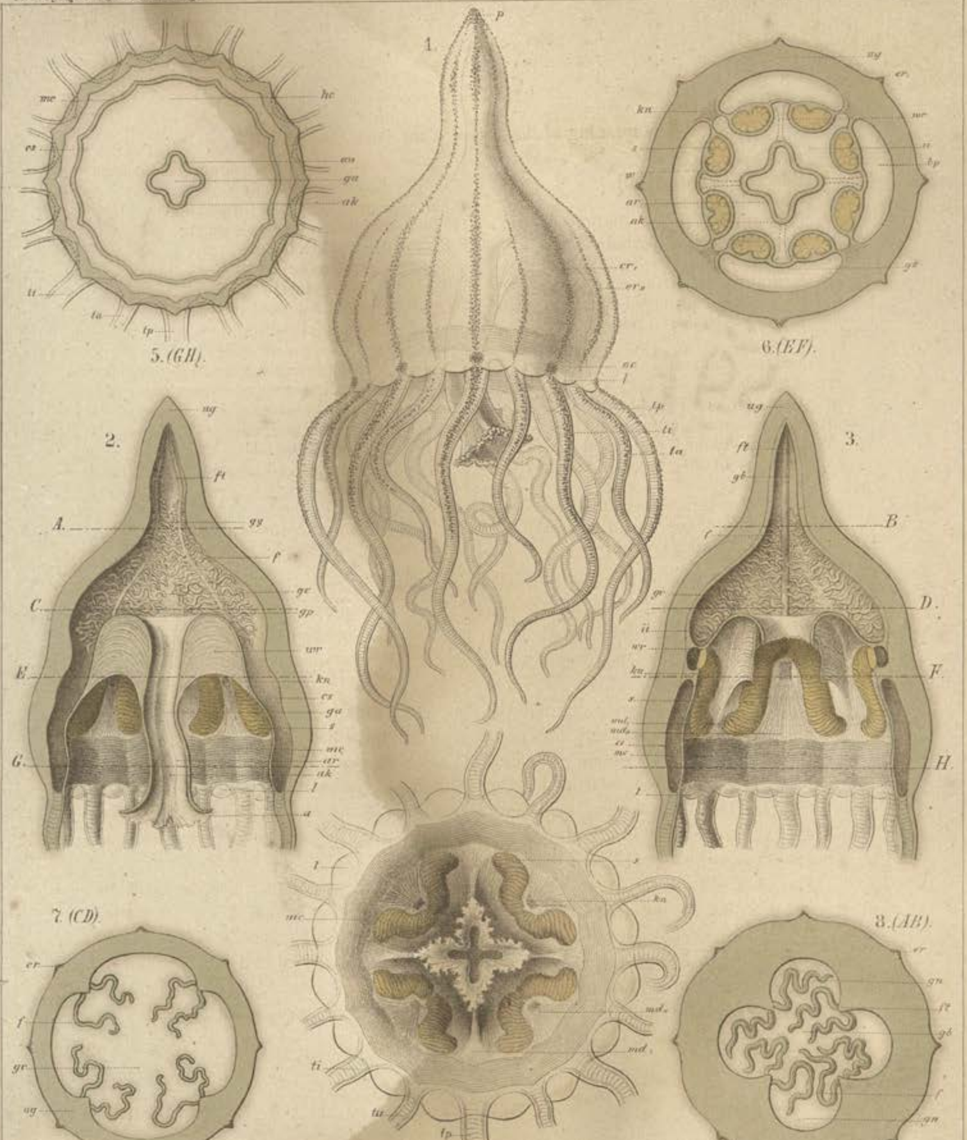
Fig. 1.—The entire Medusa in profile, ten times the natural size. Sixteen darkly pigmented longitudinal urticating ribs project on the exumbrella; eight longer principal ribs (four perradial and four interradial, *er'*), and eight alternating shorter adradial ribs (*er"*) only strongly developed below. Eight black ocelli (*oc*) lie at the base of the eight principal tentacles.

Fig. 2.—Perradial section through the umbrella, ten times the natural size; in the middle, the pendant œsophagus, fastened at its base by the mesenteries (*wr*).

Fig. 3.—Interradial section through the umbrella, ten times the natural size; the œsophagus is removed in order to show the genitalia and muscles of the subumbrella.

Fig. 4.—The subumbrella seen from below, ten times the natural size. In the middle, the perradial oral cross with the frilled oral lobes; round these the four interradial septal nodes (*kn*) and the genitalia (*g*).

Figs. 5–8.—Transverse sections through the umbrella, at the four heights, given in figs. 2 and 3, by the horizontal lines *AB*, *CD*, *EF* and *GH*. Figs. 5–7 are ten times, fig. 8 forty times, the natural size. The first transverse section, (fig. 5, *GH*) is made through the coronal sinus (*cs*) and coronal muscle (*mc*); the second (fig. 6, *EF*) through the four septal nodes (*kn*) and mesogonia (*wr*); the third (fig. 7, *CD*) through the central stomach (*gc*); and the fourth (fig. 8, *AB*) through the basal stomach (*gb*).



E.Haeckel and A.Giltsch del.

TESSERANTHA CONNECTENS.

A.Giltsch, Jena Lithogr.

PLATE XVI.

LUCERNARIA BATHYPHILA.

The meaning of the letters is the same in all the figures.

aa	Oral opening.
ak	Buccal ribs (perradial).
am	Oral margin.
bl	Lobe pouches (arm pouches).
bp	Perradial gastral pouches.
cc	Circular canal.
d	Endoderm.
e	Exumbrella.
f	Gastral filaments.
ft	Tæniola (interradial gelatinous ridges).
ga	Oral stomach (oral tube).
gb	Basal stomach (peduncle canal).
gk	Palatine nodes (perradial).
gn	Niches of the basal stomach.
go	Gastral openings (perradial).
gp	Palatine opening (porta palatina).
gy	Pyloric opening (porta pylorica).
h	Umbrella cavity.
ii	Interradial funnel cavities.
ks	Cathammal septa (interradial fused ridges).
l	Marginal lobes (arms).
md'	Perradial deltoid muscles.
md''	Interradial deltoid muscles.
ma''	Bending muscles of the arms.
mm'	Perradial marginal muscles.
mm''	Interradial marginal muscles.
nt	Urticating knobs of the tentacles (stalked sucking cups).
p	Umbrella peduncle.
pb	Adherent caudal disc (base of the peduncle).
q	Ectoderm.
g	Genitalia (ovaries).
sb	Sacs of the ovaries.
sk	Follicles of the ovarial sacs.
so	Ova.
tf	Bunches of tentacles.
ug	Gelatinous substance of the umbrella.
um	Umbrella margin.
w	Subumbrella.
wr	Mesogonia (perradial mesenteric folds).
z	Supporting plate (fulcral lamella).

Fig. 1.—The entire Medusa, in interradial profile view, the natural size.

Fig. 2.—Interradial section through the entire Medusa, one and a half times the natural size.

Fig. 3.—Perradial section through the entire Medusa, one and a half times the natural size.

Fig. 4.—Subumbral view of the entire Medusa (from below), the natural size.

Fig. 5.—Horizontal transverse section through the distal part of the body at the height of the line *CH* (fig. 3), natural size.

Fig. 6.—Horizontal transverse section through the middle part of the body (through the palatine opening), at the height of the line *EF* (fig. 3), natural size.

Fig. 7.—Horizontal transverse section through the proximal part of the body (through the gastral openings) at the height of the line *CD* (fig. 3), natural size.

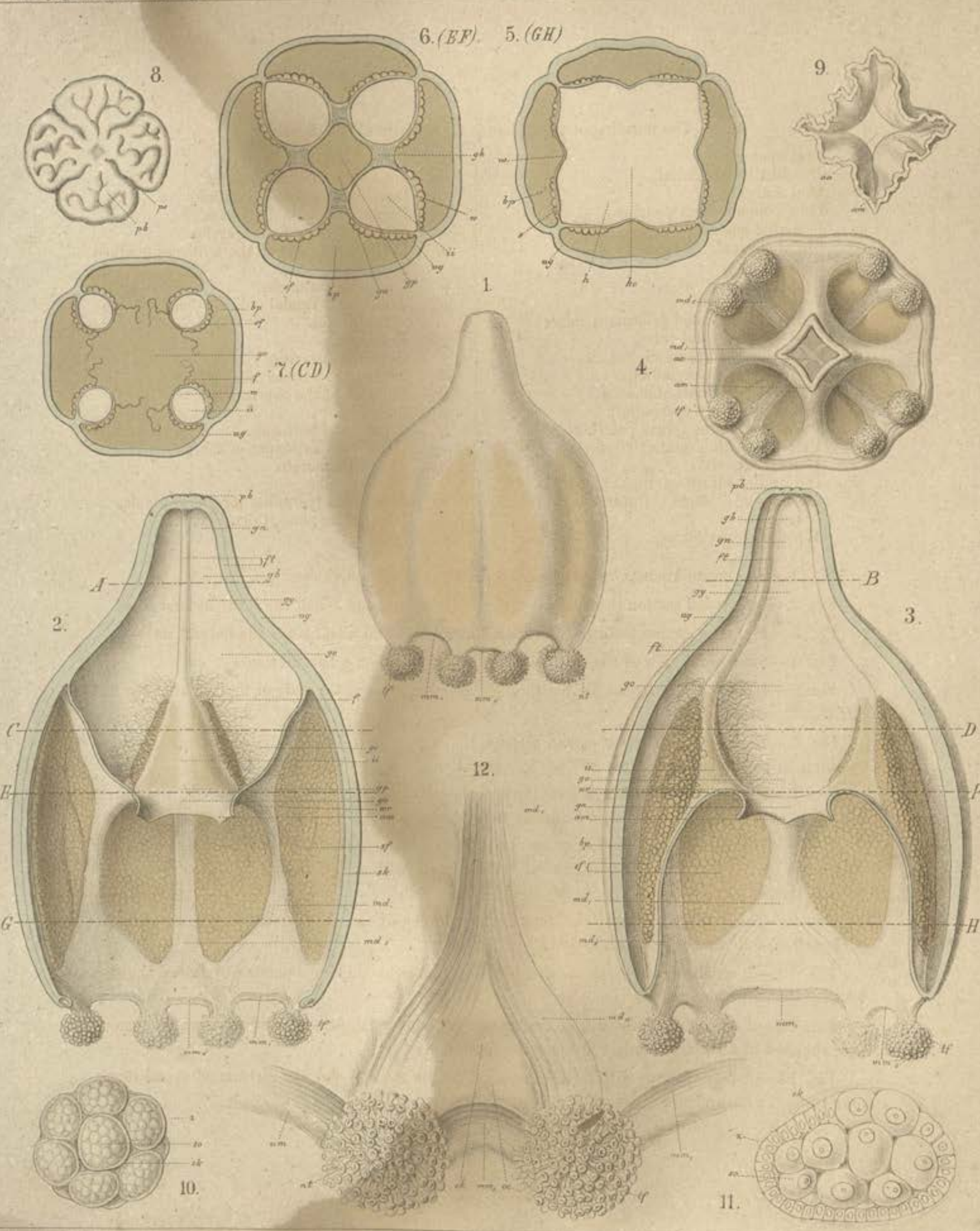
Fig. 8.—The adherent caudal disc of the umbrella peduncle seen from above (from the ectodermal surface of adhesion), with *four interradial* furrows and with irregular swellings, four times the natural size.

Fig. 9.—The oral opening with the four slightly developed oral lobes from below (seen from the oral surface) four times the natural size.

Fig. 10.—A sacculus of the ovarium, composed of numerous follicles separated by fulcral sheaths, seventy times the natural size.

Fig. 11.—A folliculus of the ovarium, composed of endodermal germinal epithelium and numerous ova, enclosed in a fulcral sheath, 300 times the natural size.

Fig. 12.—A pair of arms with their interradial deltoid muscles and the cathammal septal ridges, four times the natural size.



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E.Giltsch, Jena, lith.

LUCERNARIA BATHYPHILA.

PLATE XVII.

LUCERNARIA BATHYPHILA.

Fig. 13.—Horizontal transverse section through the umbrella peduncle above the adherent caudal disk (at the height of the line *AB*, fig. 3), twenty times the natural size. *gb* Basal stomach (central peduncle canal). *gn* Peripheric niches of the basal stomach. *ug* Gelatinous wall of the umbrella peduncle. *uf* Elastic fibres in the gelatinous wall. *q* Ectodermal epithelium of the exumbrella. *d* Endodermal epithelium of the basal stomach. *ft* The four interradial tæniola (or gelatinous longitudinal ridges of basal stomach). *z* Gelatinous plate of the tæniola. *m* Longitudinal muscles of the peduncle. *ed* The four interradial longitudinal furrows of the peduncle (on the exumbral side of the tæniola).

Fig. 14.—Horizontal transverse section through a tæniolum (or a longitudinal muscular gelatinous ridge of the umbrella peduncle), eighty times the natural size (comp. fig. 13). *d* Endoderm of the basal stomach. *ft* Gelatinous substance of the tæniolum. *m* Longitudinal muscular fibres, distributed in dendritically branched folds of the gelatinous plate. *q* Ectoderm cells (epithelial muscular cells ?) in the centre of the tæniolum.

Fig. 15.—Adradial longitudinal section through one of the eight bunches of tentacles, ten times the natural size. *bl* Lobe pouch (or "brachial cavity"). *d* Endoderm. *z* Thickened gelatinous plate. *m* Longitudinal muscle (limb of a deltoid muscle). *q* Ectoderm. The single tentacles (which all have a sucking-cup at the end) are only free in the distal half, but are all connected with each other by a gelatinous mass in the proximal half.

Fig. 16.—Longitudinal section through a sucking-cup (at the distal end of a tentacle), fifty times the natural size. *gr* Dimple-like depression in the middle of the sucking-cup, with low epithelium without nematocysts. *q* High cylindrical epithelium of the sucking-cup, with adhesive glands and nematocysts (*n*). *g* Gelatinous supporting plate. *d* Endoderm of the central tentacle canal (*ct*). *y* Peculiar conical axial cones in the cæcal distal end of each tentacle canal, which dye deep red by carmine.

Fig. 17.—Horizontal transverse section through an ovary (in the subumbral wall of a perradial gastral pouch), slightly enlarged. *qw* Ectodermal epithelium of the subumbrella. *zw* Gelatinous supporting plate of the subumbrella. *sk* The separate lobes or sacculi of the ovary, moderately enlarged (comp. fig. 11). *sb* The small follicles composing the sacs. *sc* Genital sinus. (*sl*) Oviduct. *sa* Opening of the oviduct into the radial pouch. *dw* Endoderm.

Fig. 18.—Longitudinal section through a folliculus of the ovary, moderately enlarged (comp. fig. 10). The arrows show the openings of the ovarial follicles (*sb*) by which the latter open into the "genital sinus," *sc* (or cavity of the sacculus). The sinus opens by the oviduct (*sl*) into the perradial gastral pouches. Letters as in fig. 17.

Fig. 19.—Longitudinal section through a follicle of the ovary, greatly enlarged (comp. fig. 11). *dw* Endodermal epithelium of the perradial gastral pouch. *so* Ova. *sc*" Follicle cavity, from which the mature ova reach the genital sinus (or cavity of the sacculus) by the oviductulus, *sl*" (comp. fig. 18).

Fig. 20.—Radial transverse section through the circular marginal muscle, showing the dendritic supporting folds of the fulcrum, slightly enlarged. *qw* Ectodermal epithelium of the subumbrella. *m* Muscular plate. *zw* Supporting plate of the subumbrella. *d* Endodermal epithelium of the gastral pouches.

Fig. 21.—An umbrella funnel with the adjacent gastral openings (*go*) slightly enlarged, seen from the inside. *gd* Palatine groove (oral end of the gastral opening). *gk* Ovarial sacculi. *f* Gastral filaments bordering the margins of the gastral openings). *ft* Tæniola.

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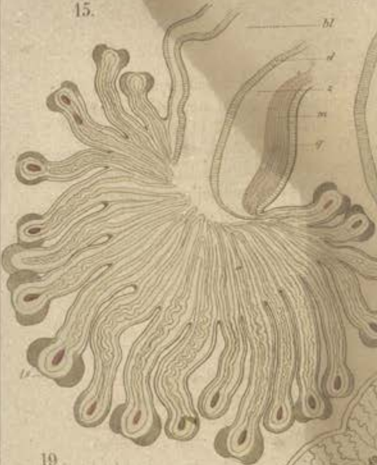

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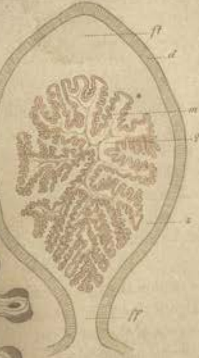

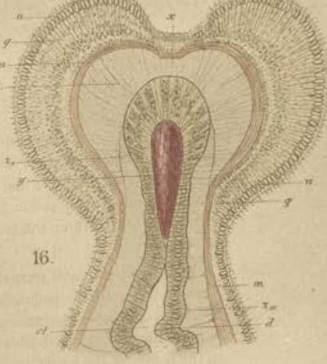

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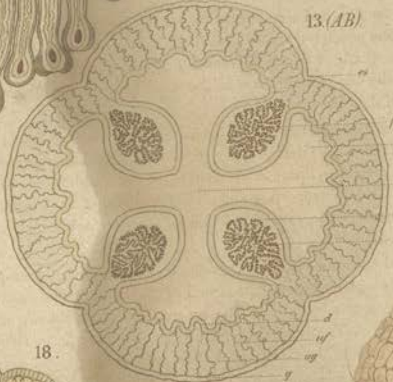

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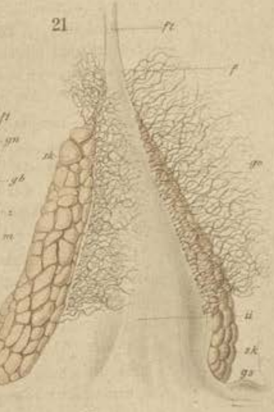

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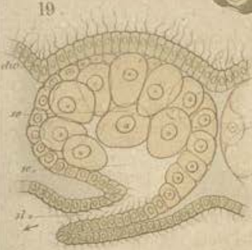

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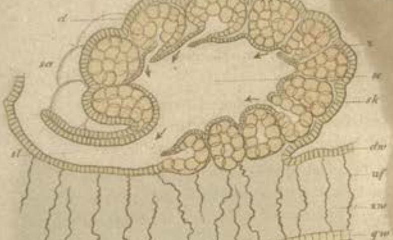

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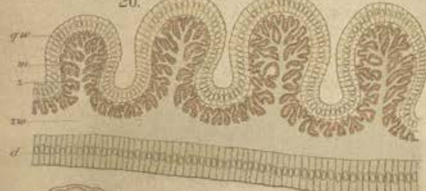

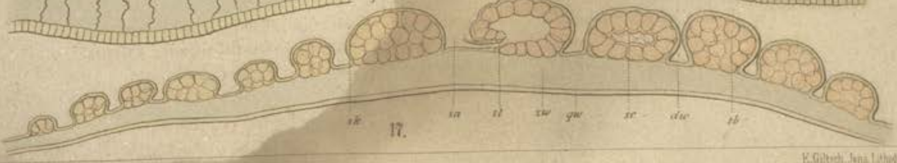

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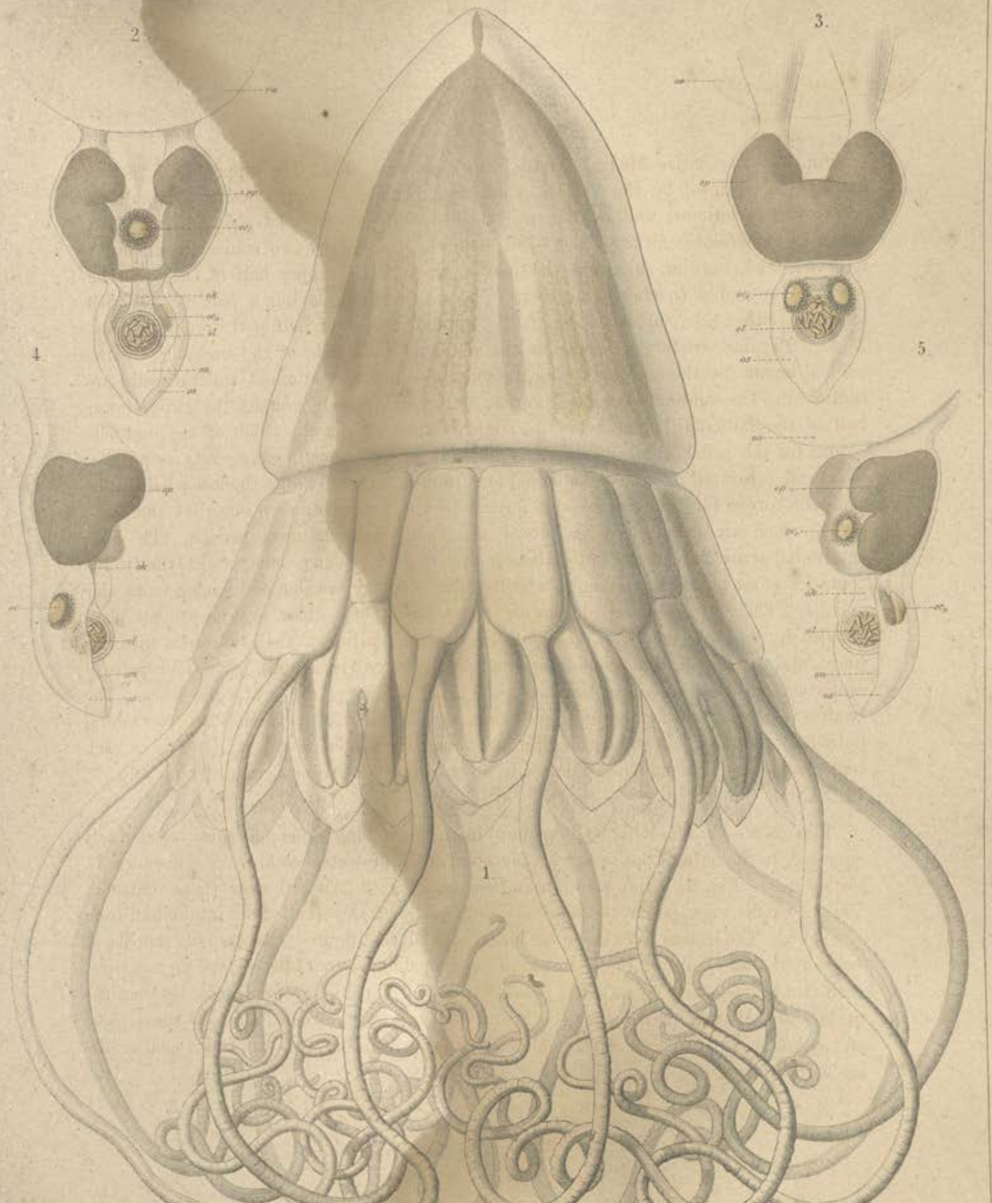
LUCERNARIA BATHYPHILA.

PLATE XVIII.

PERIPHYLLA MIRABILIS.

Fig. 1.—The entire Medusa (profile view), natural size. The upper half of the umbrella is occupied by the smooth, thick-walled umbrella cone ("conus umbralis"), whose thick gelatinous wall is traversed at the point by the basal peduncle canal. A perradial (lanceolate) niche of the basal stomach, enclosed by two conical basal (interradial) funnel cavities, shines in the middle through the upper half of the umbrella cone. A perradial (narrowly lanceolate) gastral opening, having a pair of yellowish testes on either side, shines in the middle through the lower half of the umbrella cone. A deep circular stricture is formed at the middle of the height of the umbrella, by the coronal furrow, at the bottom of which circular fibres of the exumbral zonal muscles are indicated. The umbrella corona ("corona umbralis"), which occupies the entire lower half of the umbrellas begins below the coronal furrow. The upper half of the umbrella corona (or the pedal zone) is formed by the sixteen thick gelatinous sockets or pedalia, which are separated by sixteen subradial longitudinal furrows, whilst the lower half of the umbrella corona (or the lobe zone) is formed by the corona of lobes, tentacles and sense clubs, which are fastened at the distal margin of the gelatinous pedalia. The four interradial sense clubs lie on four narrower and shorter ocular pedalia, whilst the twelve tentacles (four perradial and eight adradial) are borne by broader and longer tentacular pedalia. The sixteen subradial coronal lobes consist of a thick oval gelatinous plate divided by a deep (precisely subradial) longitudinal furrow of the exumbrella into two limbs, and of a broad, thin membraned marginal selvage (patagium). The four pairs of ocular coronal lobes are longer but narrower than the four pair of tentacular lobes. The twelve tentacles form four groups, each consisting of a middle (perradial) and two lateral (adradial) tentacles. A strong longitudinal muscle is visible on the (axial) side of each tentacle, whilst the outer abaxial side shows transverse constrictions (comp. fig. 7, Pl. XIX.).

Figs. 2–5.—A sense club (rhopalium) seen from four different sides, moderately enlarged, in the natural position, with the point of the protective scale directed downwards, distalwards. Fig. 2. Axial view (from inside). Fig. 3. Abaxial view (from outside). Fig. 4. Profile view (from the side). Fig. 5. Oblique view (half from inside, half from the side). The letters have the same meaning in all four figures. *oa* Ampulla rhopalaris, below it the two limbs of the peduncle of the rhopalium. *op* Collar-shaped pigment pad with two limbs, closed like a circle below. *oc'* Axial unpaired eye with lens, between the limbs. *oc''* Abaxial paired eye. *og* Protective scale of the rhopalium. *on* sense niche on the hollow axial surface of the scale. *ok* Stalked auditory club. *ol* Spheroidal otolite sac with crystals.



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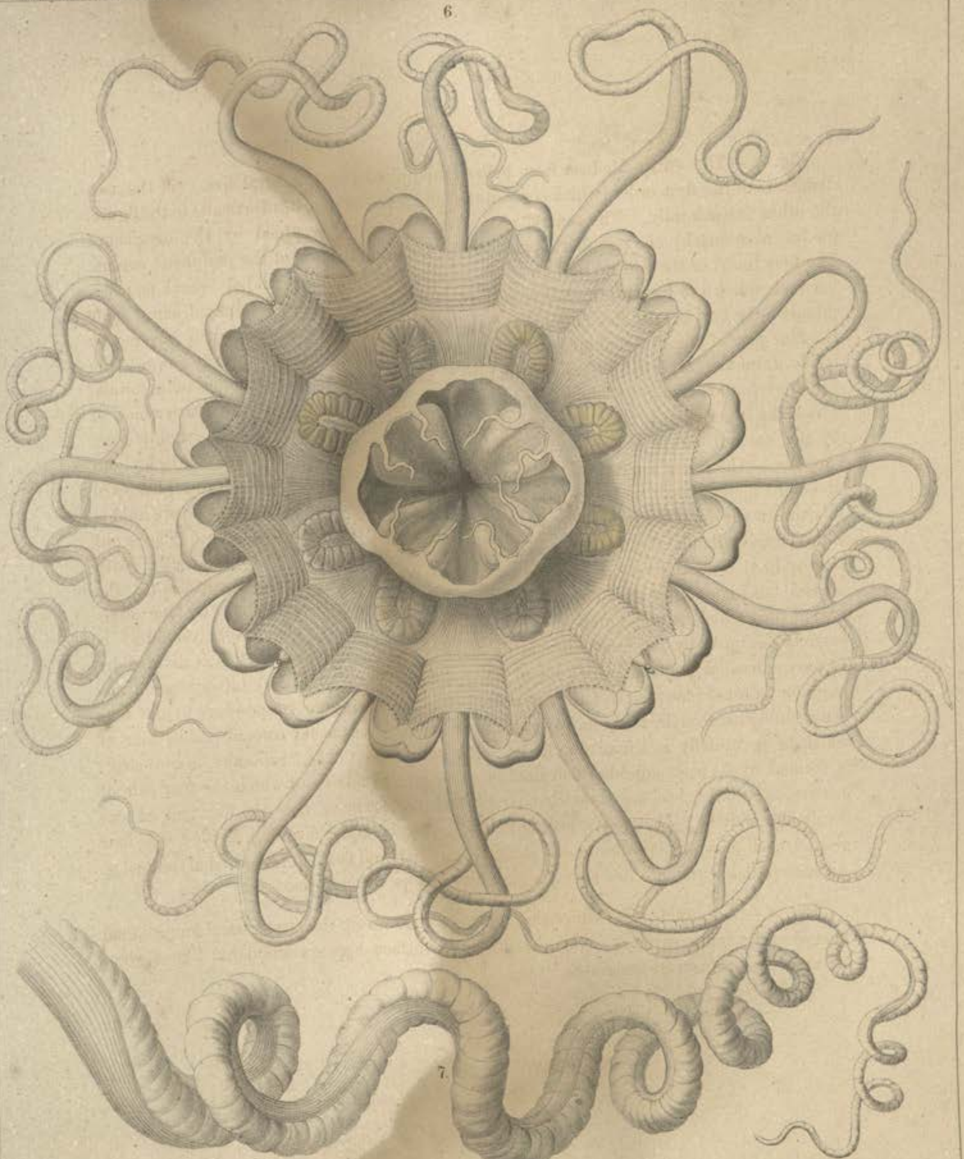
PERIPHYLLA MIRABILIS.

PLATE XIX.

PERIPHYLLA MIRABILIS.

Fig. 6.—The entire Medusa from below (subumbral view), natural size. Of the two diameters of the first order (which contain the four perradia) one lies vertically in the figure, the other horizontally. The central part of the figure is occupied by the œsophagus (or buccal stomach), the peripheric part by the subumbral view of the peripheric corona. The four limbs of the central oral cross are formed by the four perradial buccal pouches, between which the four interradial buccal columns with their broad adradial wings come prominently forward (in the diagonals of the figure). These wings are partly covered by the four pair of adradial oral filaments (barbulæ), which project centripetally towards the inside, from the inverted (clear) oral margin. The subumbrella of the umbrella corona, which surrounds the clear, almost quadrate oral margin is divided into three zones, of which the inner zone is formed by the deltoid muscles and the genitalia, the middle zone by the coronal muscle, and the outer zone by the lobe corona with its tentacles and rhopalia. The inner zone of the "subumbrella coronaris" shows the lower (oral) halves of the eight horseshoe-shaped adradial genitalia, whilst their upper (above) halves are hidden in pairs in the four interradial funnel cavities, and not visible in the figure. The eight reproductive glands (testes) are separated by eight triangular deltoid muscles (with longitudinal fibres, diverging distalwards); the four perradial deltoid muscles (in the vertical and horizontal diameter of fig. 6), are broader but shorter than the four alternating interradial deltoid muscles. The middle zone of the "subumbrella coronaris" is entirely occupied by the broad coronal muscle ("musculus coronaris"). It is divided by sixteen subradial peronia (which lie in the radia of the fourth order) into sixteen quadrangular coronal plates; the four interradial or ocular plates (corresponding to the four sense clubs) are considerably narrower than the twelve tentacular coronal plates, four of which lie perradially and four adradially. The outer zone of the "subumbrella coronaris" is formed by sixteen subradial marginal lobes or coronal lobes; of which the four pair of ocular (exradial) lobes are somewhat larger, and project more than the four pair of tentacular (corradial). The twelve strong tentacles are of equal size and divided into four groups, each of which consists of one medial (perradial) and two lateral (adradial) tentacles. An interradial sense club lies between each two groups of tentacles.

Fig. 7.—A tentacle, four times the natural size, showing the strong axial longitudinal muscle on its inner surface. The abaxial outer surface appears annulated like a worm by numerous transverse strictures.



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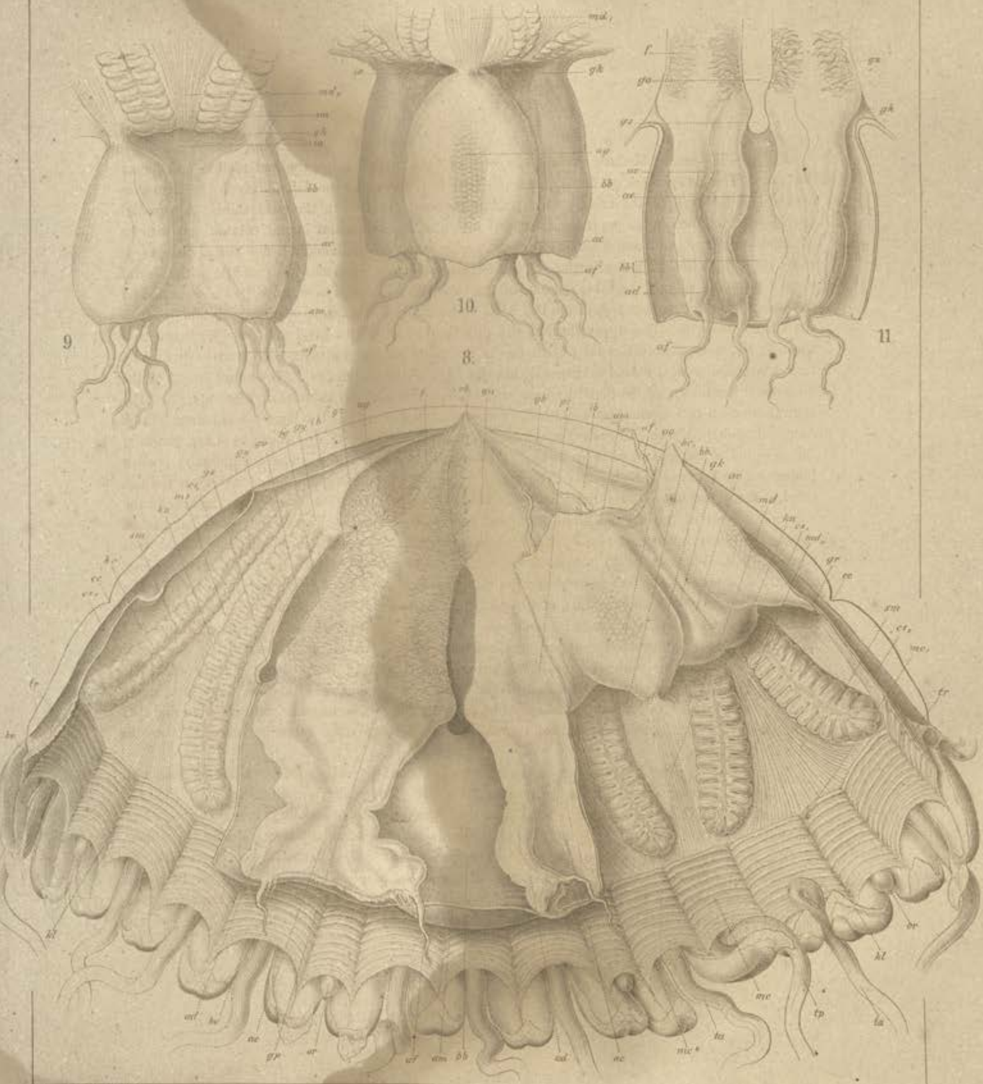
PERIPHYLLA MIRABILIS.

PLATE XX.

PERIPHYLLA MIRABILIS.

Fig. 8.—The entire Medusa, natural size, opened by a perradial longitudinal section and spread flat out. The œsophagus or buccal stomach (*ga*) is removed in the left third of the figure, is opened and flattened in the middle third, and retroverted upwards in the right third. A perradial buccal pouch of the œsophagus (from inside *bb*), and also an interradial buccal column (*ac*) with its adradial wings (*ad*) and oral filaments (*af*) are visible below in the middle. The buccal glands (*ag*) shine through on the subumbral surface of the retroverted buccal stomach. The middle of the figures gives a complete view of the three sections of the stomach. The central stomach (*gc*) is separated by the pyloric opening (pylorus *gy*) from the basal stomach, by the palatine opening (palatum *gp*) from the buccal stomach. The upper third of the principal intestine, the basal stomach (*gb*) forces itself through the narrow apical canal (*cb*) as far as the point of the umbrella cone, and is divided by four interradial conical funnel cavities (*ib*) into four peripheric niches (*gn*). The entire length of the margins of the niches are bordered by four pairs of diverging phacelli (or rows of filaments, *fb*). The central stomach (*gc*) communicates with the surrounding upper half of the large coronal sinus (*cs'*) by four fissure-shaped perradial gastral openings (*go*). The eight phacelli (*fg*) edge the entire length of the margins of the gastral ostia up to the palatine groove (*gd*). The delicate quadrangular obelisk plates (*gz*) lie between the phacelli. The entire extent of the subumbrella (*w*) is visible in the left third of the figure, but only its distal halves in the right third. The eight testes (*gm*), which lie in the subumbral wall of the coronal sinus (*cs*) form four pairs, separated by the four perradial gastral openings in their upper half (*go*), by the four palatine nodes (*gk*) in their middle, and by the four perradial deltoid muscles (*md'*) in their lower half. The two testes of each pair, on the other hand, are only separated by the four narrow interradial intergenital muscles (*ms*) in their upper half, by the four septal nodes (*kn*) in their middle, and by the four interradial deltoid muscles (*md"*) in their lower half.—The broad subumbral coronal muscle (*mc*) is divided by sixteen subradial fused clasps (*kl*) into sixteen coronal plates. Its upper proximal margin (mc_1) forms at the same time the lower boundary of the large coronal sinus. Its lower (distal) margin (mc_4) forms sixteen subradial scallops, which are inserted at the fused clasps. The concave incisions between them form small funnel cavities, from which the tentacles spring out. Of the twelve tentacles, four are perradial (*tp*) eight adradial (*ta*); the four sense clubs lie interradially. The sixteen subradial marginal lobes lie between them.

Figs. 9–11.—Three different views of the œsophagus or buccal stomach (proboscis), natural size. Fig. 9. Interradial view from outside. Fig. 10. Perradial view from inside. Fig. 11. Perradial longitudinal section, from inside. The letters have the same meaning throughout. *af* Oral filaments. *am* Oral margin. *ac* Interradial oral pillars; *ad* their adradial wings. *bb* Buccal pouches. *ag* Glands of the buccal pouches (in several longitudinal rows). *ae* Perradial buccal fissures. *io* Subumbral oral funnels (ectodermal interradial niches at the base of the œsophagus). *gk* Perradial palatine nodes, between the funnels. *gd* Palatine grooves on their axial surface. *t* Lowest gastral filament. *go* Gastral openings. *md"* Interradial deltoid muscle. *gm* Spermaria.



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PERIPHYLLA MIRABILIS

PLATE XXI.

PERIPHYLLA MIRABILIS.

N.B.—The solid gelatinous mass of the umbrella is coloured blue, the subumbral wall of the umbrella cavity, and the funnel cavities running out from it, violet, and the whole hollow space of the gastrovascular system, yellow.

The letters have the same meaning in all the figures.

ac	Oral columns (interradial).
ad	Wings of the oral columns (adradial).
ae	Buccal clefts (perradial).
af	Oral filaments (adradial).
bb	Buccal pouches (perradial).
bc	Coronal pouches.
bd	Wing pouches (adradial).
bl	Lobe pouches.
bp	Gastral pouches (perradial).
cb	Peduncle canal of the umbrella cone.
cs	Coronal sinus (sinus coronaris).
ct	Tentacle canal.
d	Endoderm.
ec	Coronal furrow of the exumbrella.
f	Gastral filaments.
fb	Filaments of the basal stomach.
fg	Filaments of the central stomach.
ga	Buccal stomach.
gb	Basal stomach.
gc	Central stomach.
gk	Palatine nodes (perradial).
gn	Niches of the basal stomach (perradial).
go	Gastral openings (perradial).
gp	Palatine opening (porta palatina).
gs	Palatine grooves (perradial).
gy	Pyloric opening (porta pylorica).
gz	Obelisc plates of the central stomach.
h	Umbrella cavity.
i	Subumbral funnel cavities.
ib	Basal funnels.
ii	Central funnel.
kl	Fused clasps of the lobes (peronia).
kn	Cathammal nodes (interradial).
lp	Selvedge of the marginal lobes (patagium).
mc	Coronal muscle (musculus coronaris).
md	Deltoid muscles.
n	Urticating organs.
or	Sense clubs (interradial).
q	Ectoderm.
sm	Testes (four pairs).
ta	Adradial tentacles.
tp	Perradial tentacles.
ua	Adradial tentacles pedalia.
ug	Gelatinous substance of the umbrella.
ui	Interradial pedalia of the sense clubs.
up	Perradial tentacle pedalia.
w	Subumbrella.
y	Supporting plates (fultura).

Figs. 12–21.—Longitudinal sections and transverse sections three-fourths the natural size (only fig. 21 is ten times the natural size).

Fig. 12.—Perradial longitudinal section through the entire animal (meridian section of the first order).

Fig. 13.—Interradial longitudinal section through the entire animal (meridian section of the second order).

Fig. 14 (*AB*).—Horizontal transverse section through the basal stomach (at the height of the line *AB*, figs. 12, 13).

Fig. 15 (*CD*).—Horizontal transverse section through the pyloric opening (at the height of the line *CD*, figs. 12, 13).

Fig. 16 (*EF*).—Horizontal transverse section through the central stomach (at the height of the line *EF*, figs. 12, 13). (Half).

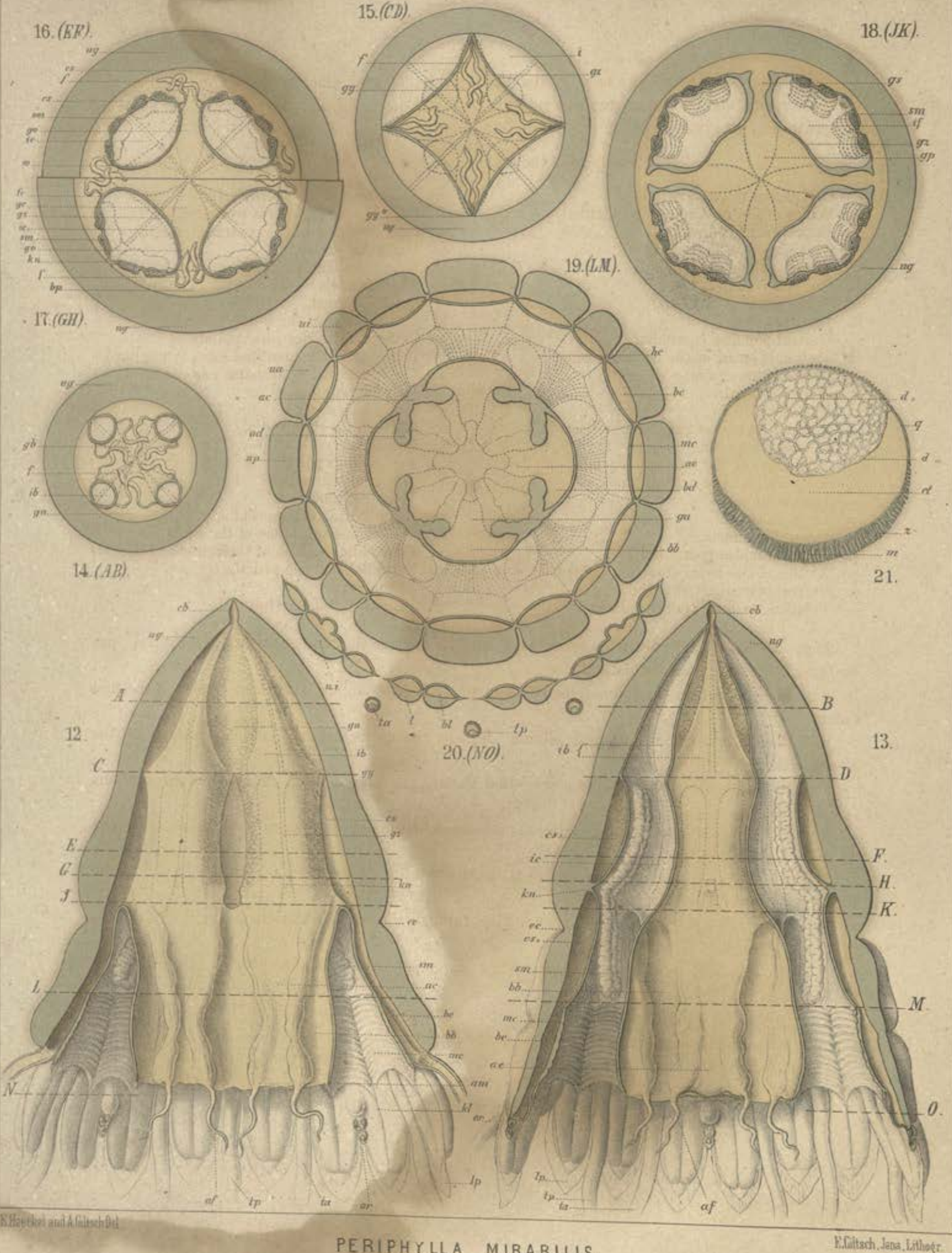
Fig. 17 (*Gh*).—Horizontal transverse section through the central stomach at the height of the line (*GH*, figs. 12, 13). (Half).

Fig. 18 (*JK*).—Horizontal transverse section through the palatine opening (at the height of the line (*JK*, figs. 12, 13).

Fig. 19 (*LM*).—Horizontal transverse section through the pedal zone of the umbrella, along with the coronal muscle and buccal stomach (at the height of the line *LM*, figs. 12, 13).

Fig. 20 (*NO*).—Part of a horizontal transverse section of the lobe corona (at the height of line *NO*, figs. 12, 13).

Fig. 21.—Transverse section through a tentacle, ten times the natural size.



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PERIPHYLLA MIRABILIS.

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PLATE XXII.

PERIPHYLLA MIRABILIS.

Fig. 22.—A quadrant of the umbrella corona with a sense club in the middle, twice the natural size, subumbral view. Exactly in the middle of the figure, we see an interradial rhopalium (*or*), half concealed by its ampulla (*oa*) into which a spheroidal air bubble has found its way. A sense lobe (*lo*), the point of whose marginal selvedge is turned over inwards (above), is visible on either side of the sense club (*or*). Next comes an adradial tentacle (*ta*), then a tentacle lobe (*lt*), and finally a perradial tentacle (*tp*). Only the basal parts of the tentacles are given. The coronal muscle (*mc*), whose upper or proximal margin (mc_1) forms the lower or distal boundary line of the large coronal sinus (*cs*), is drawn in the right half of the figure. The subumbral surface of the coronal muscle is laid in ten to twelve strong circular folds (mr_2) which decrease in height the lower they are and alternate with the same number of circular furrows (mc_3). The lower or distal margin of the coronal muscle (mc_4) is inserted with a projecting point in the middle of each marginal lobe (at its fused clasp *kl*), whilst it forms a projecting roof, under which a small subumbral funnel cavity remains open (*it*) above the basal insertion of each tentacle and each sense club. The broad distal margins of insertion of the longitudinal deltoid muscles, the perradial (*md'*) and the interradial (*md''*), are visible above the upper margin of the coronal muscle (mc_1). Each of the four visible marginal lobes (*l*) is surrounded at the free distal margin by a delicate folded membraneous selvedge ("patagium, *lp*"), and is halved in the middle by a strong cartilage-like fused clasp ("cathamma lobare," *kl*). This arises by a fusion of the umbral and subumbral wall of the lobe pouch, by means of which the latter is divided into two parallel canals (*bl*). But as the thickened distal end of the fused clasp (*kl*) does not reach to the distal end of the lobe pouch but stops above it, the two parallel canals of each lobe communicate below by a U-shaped "horse shoe canal," whilst they open separately above into the coronal sinus (*cs*). In the left lobe of the figure, a large air bubble expands the horse shoe canal enclosing the distal end of the fused clasp (*kl''*) in its concavity. In the adjacent ocular lobe, the horse shoe canal is opened and its subumbral wall retroverted on both sides; we see the branched, blackish streaks of pigment (*gd*, glands ?) which lie along the fused clasp (*kl*) in the umbral wall (*dn*). In the figure to the left above, the coronal muscle is removed for the most part to show the peculiar insertion of the tentacle (*tp*), with its two root muscles (*mk*), and also the peculiar septal fissure (*bc''*) by which the abaxial avelar pouch (*bc'''*) communicates with the axial velar pouch (*bc'*). The sequent (second) tentacle (left from the sense club) is cut off short below its insertion (*ct*). The third tentacle (right from the sense club) is cut open at the base of its length in order to show the remarkable double valved vent hole which separates the tentacle cavity (*ct*), from the coronal pouch (*bc*). The roundish cavity of the venthole (*ev*) opens between the upper (*yk'*) and the lower (*yk''*) vent valve.

Fig. 23.—A band-shaped gastral filament, six times the natural size.

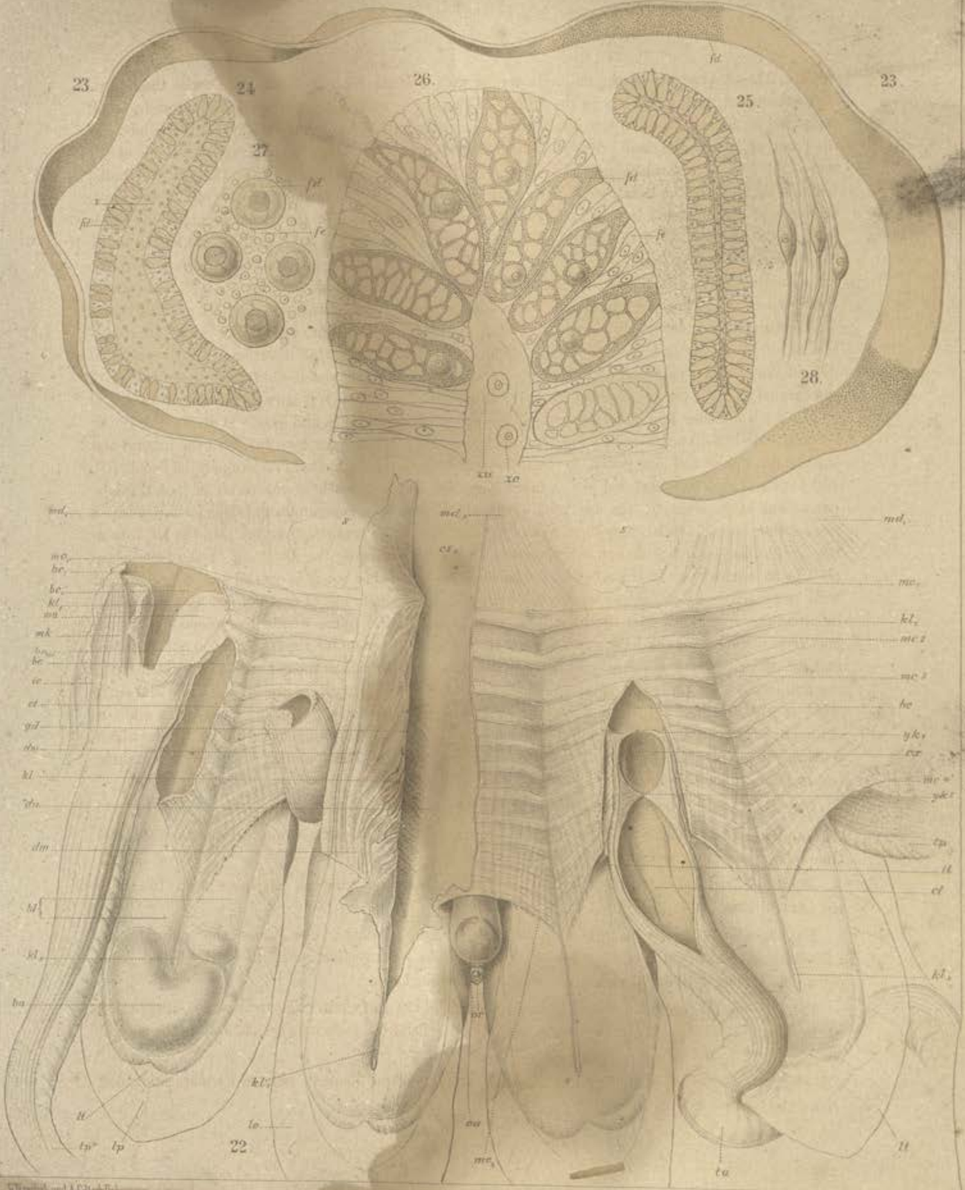
Fig. 24.—Transverse section though a thick gastral filament, with strong gelatinous plate, 100 times the natural size.

Fig. 25.—Transverse section through a thin gastral filament, with weak gelatinous plate, 100 times the natural size.

Fig. 26.—End of the narrow margin of a gastral filament, 600 times the natural size. *z* Supporting gelatinous plate. *ze* Cells of the gelatinous plate (colloblasta). *fd* Bottle-shaped gland cells. *fe* Narrow cylindrical endoderm cells between the glands.

Fig. 27.—Small piece of a gastral filament, seen from the surface in order to show the distribution of the gland cells (*fd*) between the narrow cylindrical cells of the endoderm (*fe*), 600 times the natural size.

Fig. 28.—Gastral epithelial muscular cells (?) from a gastral filament, isolated by maceration, 600 times the natural size.



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PERIPHYLLA MIRABILIS.

PLATE XXIII.

PERIPHYLLA MIRABILIS.

Fig. 29. A piece of the umbrella corona, with a marginal lobe (*l*) and the proximate insertion of a tentacle, twice the natural size. The subumbral wall with the coronal muscle has been removed in order to show the condition of the opened pouch. The two parallel lobe canals (*bl*) of the lobe which are separated by the fixed clasp (*kl*) are connected below its distal end (*kl''*) by the U-shaped horse shoe canal (*bw*). The upper (*kl'*) and the lower (*kl''*) end of the fibrous cartilaginous fused clasp are thickened. *lp* Delicate margin selvedge of the lobe (patagium). *cs''* Distal margin of the coronal sinus, *mk* root muscles of the tentacle (*t*). *du* umbral wall of the coronal pouch. *bc''* Septal fissure, between the two root muscles (*mk*) which represents the communication between the axial velar pouch (*bc'*) and the abaxial avelar pouch (*bc'''*). Comp. fig. 22.

Fig. 30. Perradial longitudinal section through a tentacle (*t*) and the coronal pouch (*bc*) belonging to it, natural size. *mk* Root muscle of the tentacle. *cv* Vent hole of the tentacle. *mc* Coronal muscle. *l* Marginal lobes. *kl* Fused lobe. *lp* Patagium. *ec* Coronal furrow. *cs* Coronal sinus. *ug* Gelatinous substance of the umbrella.

Fig. 31. Interradial longitudinal section through a sense club (*or*) and the coronal pouch belonging to it (*bc*), natural size. *oa* Ampulla of the rhopalium (*or*). *bl* Lobe pouch. *mw* Subumbrella. *ug* Gelatinous substance of the umbrella. *ec* Coronal furrow of the exumbrella. *cs* Coronal sinus; *du* its umbral endoderm. *bc* Coronal pouch. *mc* Coronal muscle.

Fig. 32. A sense club (*or*) with its ampulla (*oa*) and the two bordering ocular lobes (*l*), seen from below, twice the natural size. The two lobes are drawn apart and retroverted. *lp* Patagium of the lobes. *kl* Fused clasps. *mc* Coronal muscle. *ta* Adradial tentacles.

Fig. 33. An interradial cathamma or septal node (*kn*) seen from the subumbrella, twice the natural size; having the intergenital muscle (*ms*) above, the interradial deltoid muscle (*md''*) below.

Fig. 34. A bit of the exumbral zonal muscle ("M. zonaris," *mz*) along with the two subradial triangular points (*mz''*) which it sends out in the longitudinal furrow between two pedalia (*ud*). *ec* Coronal furrow of the exumbrella (thinnest part of the gelatinous body). Twice the natural size. (Comp. fig. 35.)

Fig. 35. Radial section through the exumbral coronal furrow (*ec*) and the exumbral zonal muscle (*mz*) lying beneath it. *ug* Gelatinous substance of the umbrella. *du* Endodermal epithelium of its abaxial side. *ge* Ectodermal epithelium of its abaxial side. Twice the natural size (comp. fig. 34).

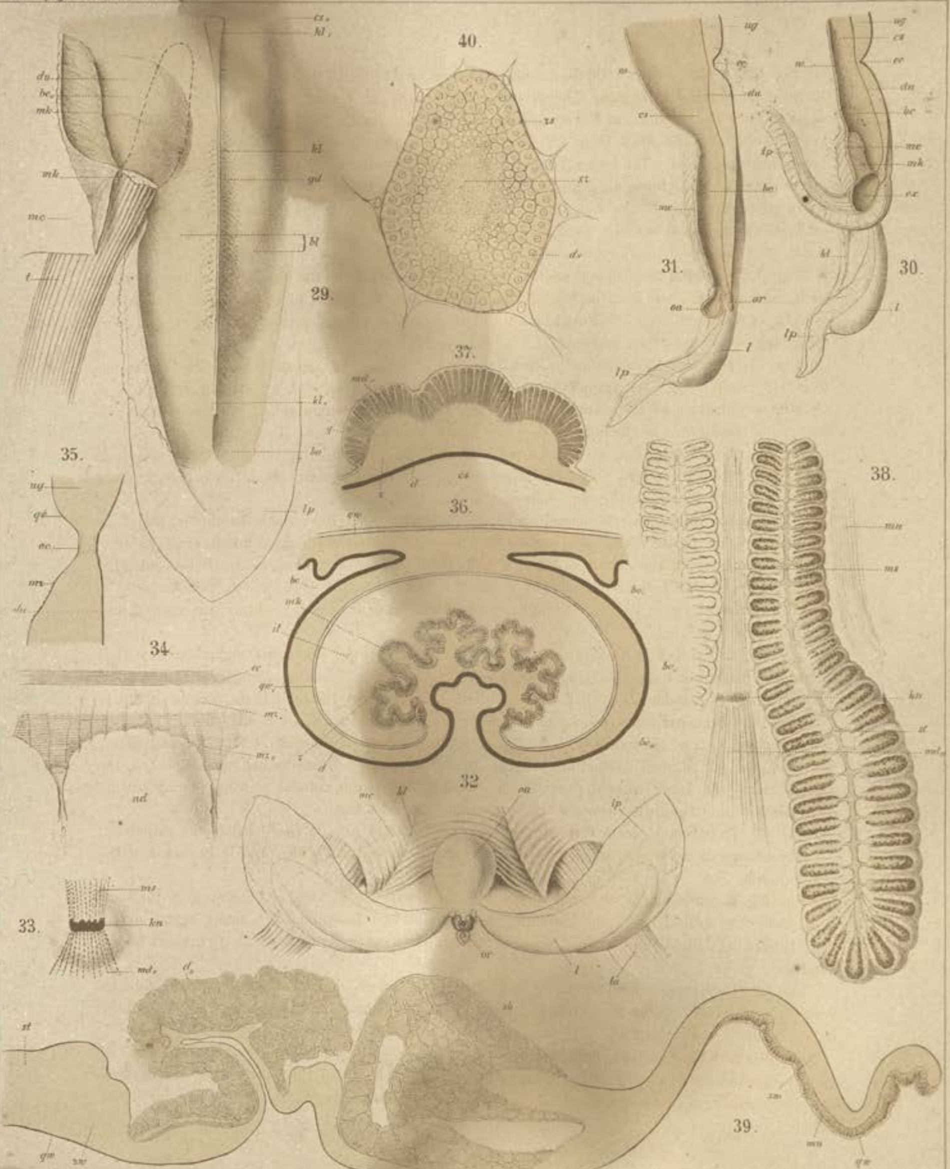
Fig. 36. Horizontal transverse section through the root muscle of a tentacle, slightly enlarged. *mk* Muscular folds of the root muscle; *z* its supporting plate. *it* Subumbral funnel cavity of the tentacle. *qr* Ectodermal epithelium of the funnel cavity. *qw* Ectodermal epithelium of the subumbrella. *bc'* Inner coronal pouch (velar pouch). *bc'''* Outer coronal pouches (avelar pouch). *bc''* Fissure of communication between the two pouches (septal fissure).

Fig. 37. Transverse section through the interradial deltoid muscle (*md''*) below the cathamma, slightly enlarged. *g* Supporting plate. *d* Endoderm of the coronal sinus (*cg*). *q* Ectoderm of the subumbrella.

Fig. 38. A genitalium (sperarium) along with the upper part of another genitalium of the same pair, twice the natural size. *mg* Musculus intergenitalis. *kn* Interradial cathamma (septal nodes). *md''* Interradial deltoid muscle. *mn* Musculis congenitalis. *gt* Sterigma genitalie (framework of the testis).

Fig. 39. Transverse section through a fold of the spermarium, slightly enlarged. *gb* The follicles comprising the fold. *gt* Sterigma (fulcral framework) of the spermarium. *zw* Supporting plate of the subumbrella. *qw* Ectoderm of the plate. *mn* Musculus congenitalis.

Fig. 40. A follicle of the spermarium greatly enlarged. *gt* Sterigma (endodermal), framework of the spermarium, made of connective tissue, and forming sheaths round the follicles. *dg* Endodermal germinal epithelium (in the periphery of the follicle). *gz* Mature spermatozoa in the interior of the follicle.



PERIPHYLLA MIRABILIS.

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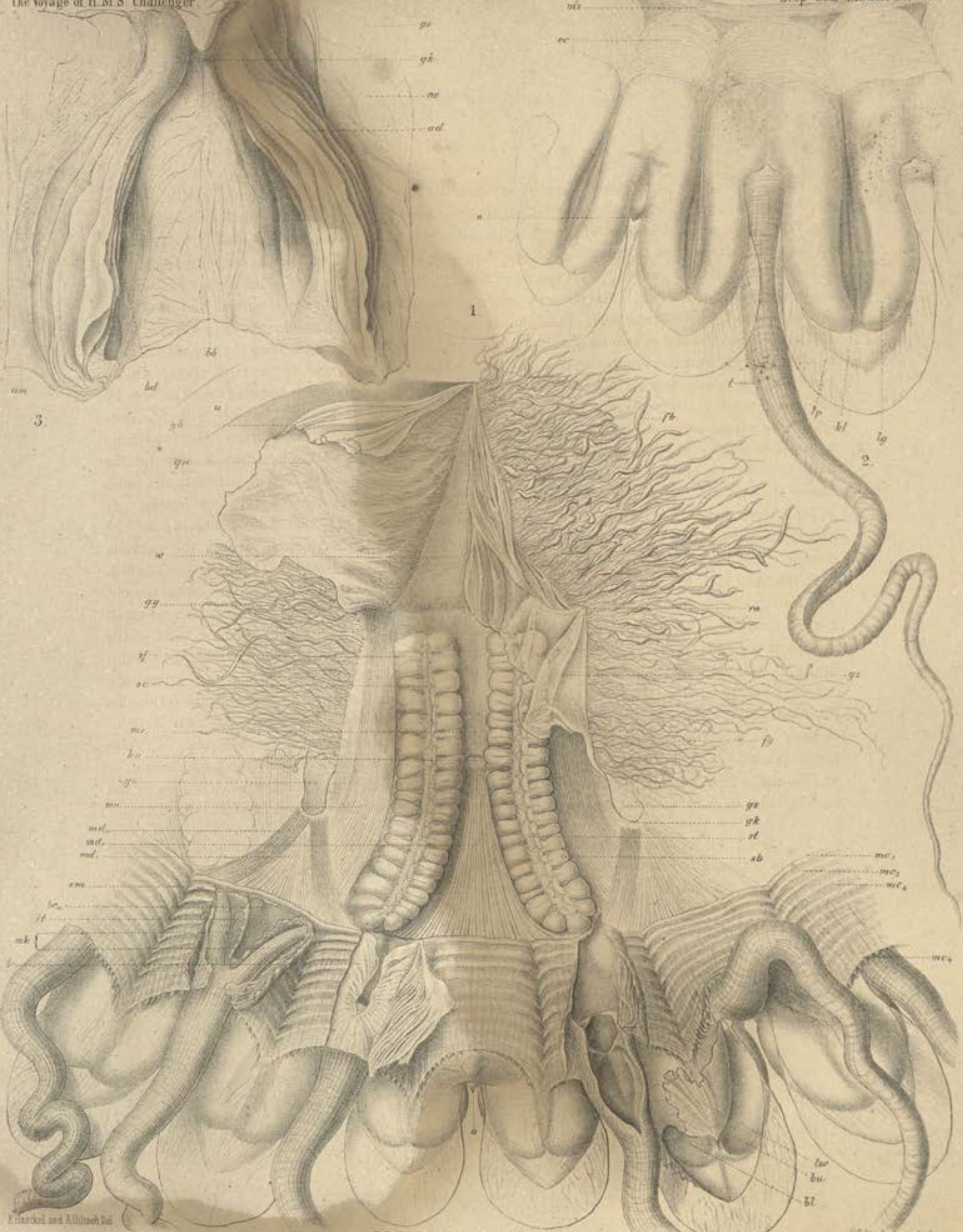
PLATE XXIV.

PERIPHEMA REGINA.

Fig. 1.—A quadrant of the umbrella, subumbral view, natural size (the only portion of this species preserved). The greater part of the principal intestine (especially the whole buccal stomach, fig. 3) was torn away. An opened funnel cavity (*ib*) of the basal stomach (*gb*) is visible in the middle of the upper third of the figure. We see the torn, folded subumbral wall of the funnel cavity, whose ectodermal subumbral surface (*qw*) is spread out flat to the left, whilst part of its endodermal gastral surface (*gb*) is turned over. The powerful bush of the enormously developed gastral filaments (*fb*), which extend from the basal point of the funnel nearly as far as the palatine groove (*gk*), is visible to the right. The pylorus or pyloric opening (*gy*) separates the basal stomach from the central stomach, of which only a torn fragment of an obelisk plate (*gz*) has been preserved, to the right above. In the middle of the figure we see a more complete quadrant of the subumbrella, bounded on either side by the cleft-shaped gastral openings (*go*). The margins of the latter are thickly beset with filaments (*fg*), from which, however, the lowest part with the palatine groove remains free. The interradial cathammal nodes (*kn*) gleam through the middle of the subumbral wall of the coronal sinus (at the same time in the centre of the whole figure). The intergenital muscle (*mg*) is joined to the nodes above the interradial deltoid muscle (*md''*) below. The latter separates the two ovaries (*sf*). *gt* Midrib (sterigma) of each ovary. *mn* Congenital muscle. *md* Perradial deltoid muscle; *md'''* its paired marginal bundles. The lower third of the figure gives the subumbral view of the umbrella corona, whose upper boundary is formed by the proximal margin of the coronal muscle (mc_1) (which is at the same time the distal margin of the coronal sinus). mc_2 Circular folds of the coronal muscle. mc_3 Furrows between the folds. mc_4 Distal margin of the coronal muscle (with numerous small coronal furrows). A sense club (*o*) with the round ampulla above it is visible in the middle of the margin of the umbrella corona; three tentacles and three marginal lobes on either side. The subumbral wall of one lobe (the second from the right) is opened in order to show how the two lobe canals (*bl*) (separated by the fused clasp) are connected by the U-shaped horseshoe canal (comp. fig. 22, Pl. XXII.). Three of the seven visible areæ of the coronal muscle have been cut away in order to show the complications of the tentacle insertion. *mk* Root muscles of the tentacle. *bc'* Velar pouch (axial). *bc'''* Avelar pouch (abaxial), the septal fissure by which the two communicate, is visible in the third tentacle (from the left). The fourth tentacle (from the left) is cleft open to the base in order to show the vent cavity with the double valved vent hole (comp. Pl. XXII. fig. 22, *cx*).

Fig. 2.—A bit of the umbrella corona from outside (exumbral view), natural size. *mz* Zonal muscle in the broad coronal furrow (*ec*). *kl* Fused clasp. *lg* Gelatinous swelling of the lobes on either side of the clasp. *lp* Delicate wing selvedge of the marginal lobes. *t* Tentacles. *o* Sense clubs.

Fig. 3.—Quadrant of the œsophagus or buccal stomach from the inner surface, natural size. *gs* Palatine groove. *gb* Palatine nodes. *bb* Perradial buccal pouches; *bd* their lateral wing pouches. *ac* Interradial fleshy oral columns; *ad* their thickly folded adradial wings. *am* Margin of the mouth.



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PERIPHEMA REGINA.

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PLATE XXV.

PERIPHEMA REGINA.

Fig. 4.—A mature ovum, 100 times the natural size. The spheroidal egg cell is enclosed in a thick structureless chorion (*yc*); a projecting micropyle (*ym*) opens at one point of it. The yolk is composed of spheroidal, thickly compacted yolk granules (*yd*) of equal size. The clear spheroidal germinal vesicle (*yn*) contains a large dark germinal nucleus (*yf*), and this, again, a visible double contoured germinal nucleolus (*yp*).

Fig. 5.—A follicle of the ovary, seen from the inner (endodermal and abxial) surface, four times the natural size. The ova are distributed on the free endodermal surface (turned to the coronal sinus) of the fan-shaped transverse folds of the follicle in such a way that the smallest and younger ova lie on the basal margin of insertion of the folds, but the larger and older on its freely projecting margin.

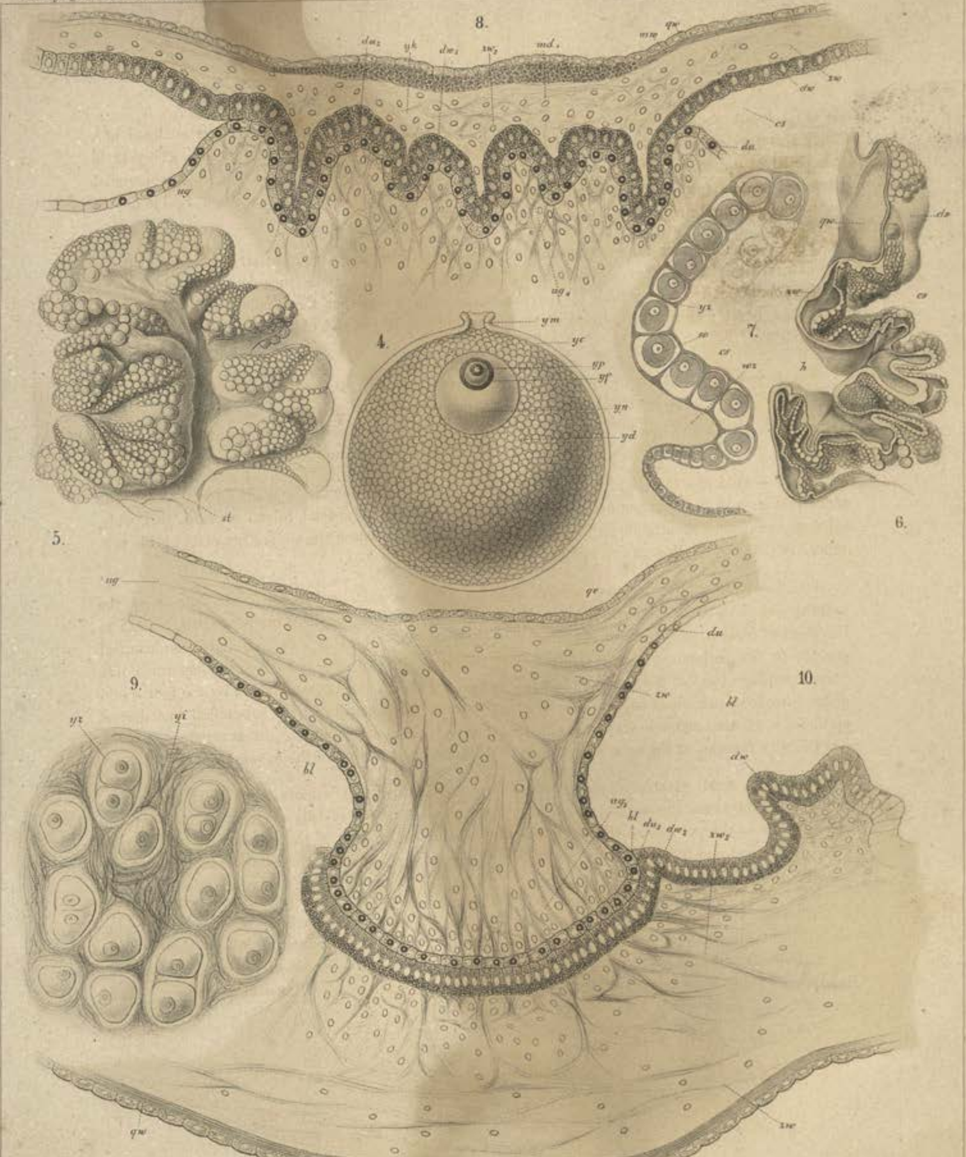
Fig. 6.—A follicle of the ovary in longitudinal section, four times the natural size. The flat axial ectodermal surface of the subumbrella (*qw*) is separated by a thick gelatinous fulcral plate (*zw*) from the thickly folded abaxial endoderm surface, from whose germinal epithelium (*ds*) the ova are originated. *h* Umbrella cavity. *cs* Hollow cavity of the coronal sinus.

Fig. 7.—Fold of a follicle of the ovary in longitudinal section, eight times the natural size. The more mature ova (*so*) surrounded by a chorion, are enclosed in special fulcral capsules (*yz*), wide, separate, gelatinous sheaths formed by a superficial abaxial growth of the supporting plate of the subumbrella (*uz*). *cs* Hollow cavity of the coronal sinus.

Fig. 8.—Horizontal transverse section through an interradial cathammal node, 300 times the natural size. *ug* Gelatinous substance of the umbrella, transformed into fibrous cartilage (ug_2) at the point of fusion. du_2 Umbral endodermal lamella of the cathamma. dw_2 Subumbral endodermal lamella of the cathamma. *zw* Gelatinous supporting plate of the subumbral transformed into fibrous cartilage (zw_2) at the point of fusion. *cs* Coronal sinus (in this case divided by the four septal nodes into four perradial spaces). *du* Umbral endodermal epithelium; *dw* subumbral endodermal epithelium of the coronal sinus. *md*" Insertion of the deltoid muscle (in transverse section). *mw* Circular muscles of the subumbrella. *qw* Endodermal epithelium of the subumbrella.

Fig. 9.—A small piece of fibrous cartilage from the hardened gelatinous tissue of the cathamma (fig. 8, ug_2), 600 times the natural size. The histological structure of this modified gelatinous tissue immediately at the point of fusion is similar to the fibrous cartilage of the vertebratæ. *yz* Cartilaginous cells enclosed in cartilaginous capsules. *yi* Fibrous cords of the intercellular substance.

Fig. 10.—Horizontal transverse section through a fused clasp, 300 times the natural size. *qu* Ectodermal epithelium of the exumbrella. *qw* Ectodermal epithelium of the subumbrella. *du* Umbral endodermal epithelium. *dw* Subumbral endodermal epithelium of the lobe pouch. *ug* Gelatinous substance of the umbrella transformed in ug_2 into fibrous cartilage. *zw* Gelatinous substance of the subumbrella transformed in zw_2 into fibrous cartilage. *kl* Cathamma lobare. *bl* Lobe pouches.



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PERIPHEMA REGINA.

PLATE XXVI.

CHARYBDEA MURRAYANA.

The letters have the same meaning in all the figures.

ao	Oral opening.
al	Oral lobes.
bm	Adradial marginal lobes.
bp	Perradial gastral pouches.
ct	Tentacle canals.
cv	Velarium canals.
dk	Cathammal plates (or endodermal lamellæ of the septa).
du	Endoderm of the umbrella
dw	Endoderm of the subumbrella.
e	Exumbrella (external surface of the umbrella).
ea	Exradial exumbral furrows.
ec	Coronal furrow of the exumbrella.
ei	Interradial exumbral furrows.
eo	Sense niche of the exumbrella.
ep	Perradial exumbral furrows.
f	Gastral filaments.
gb	Basal stomach.
go	Gastral openings (perradial).
gp	Palatine stricture.
gs	Palatine groove.
gy	Pyloric valves.
gw	Subumbral wall of the stomach.
h	Umbrella cavity.
i	Interradial funnel cavities.
it	Tentacle funnels (axial cavities).
ks	Cathammal ridges (septa).
mi	Interradial longitudinal muscles of the subumbrella.
mp	Perradial longitudinal muscles of the subumbrella.
mw	Layer of circular muscles of the subumbrella.
or	Rhopalia (perradial sense clubs).
qw	Ectoderm of the subumbrella.
rc	Nerve ring.
s	Leaf-shaped genitalia.
sd	Germinal epithelium of the endoderm.
so	Ova cells.
t	Tentacles.
u	Umbrella.
uf	Elastic fibres of the gelatinous umbrella.
ug	Gelatinous substance of the umbrella cone.
ui	Gelatinous sockel (pedalia).
va	Velarium.
vf	Frenula velarii.
vm	Free margin of the velarium.
w	Subumbrella (inner surface of the umbrella).
wr	Mesogonia (mesenteric folds).
z	Supporting plate (fulcral lamella).
zg	Supporting plate of the genitalia.
zw	Fulcrum of the subumbrella.

Fig. 1.—The entire Medusa profile view, natural size. We see two sides of the cubical umbrella, which touch at the interradial furrow of the angle (*ei*).

Fig. 2.—Perradial section through the umbrella, natural size. On either side we look into an opened radial pouch (*bp*). The complete middle radial pouch is mostly occupied by the leaf-shaped genitalia, which project from the interradial septal ridges (*ks*).

Fig. 3.—Interradial section through the umbrella, natural size. We see two side walls of the cubical subumbrella, which meet in the septal ridges (*ks*) in the interradial angles and whose coronal muscle is halved by the perradial band-shaped longitudinal muscle (*mp*).

Fig. 4.—Subumbral view of the umbrella, from above (from the apical surface), natural size. In the middle the cross of the perradial gastral grooves (*gs*) gleams through the quadrate apex.

Fig. 5.—Subumbral view of the umbrella from below (from the surface of the oral opening) natural size. Through the opening of the velarium (*va*) in the bottom of the umbrella cavity, we see the bottom of the stomach with its subumbral circular muscles (*gw*) and perradial gastral grooves (*gs*); in the middle the oral cross with the oral lobes (*al*).

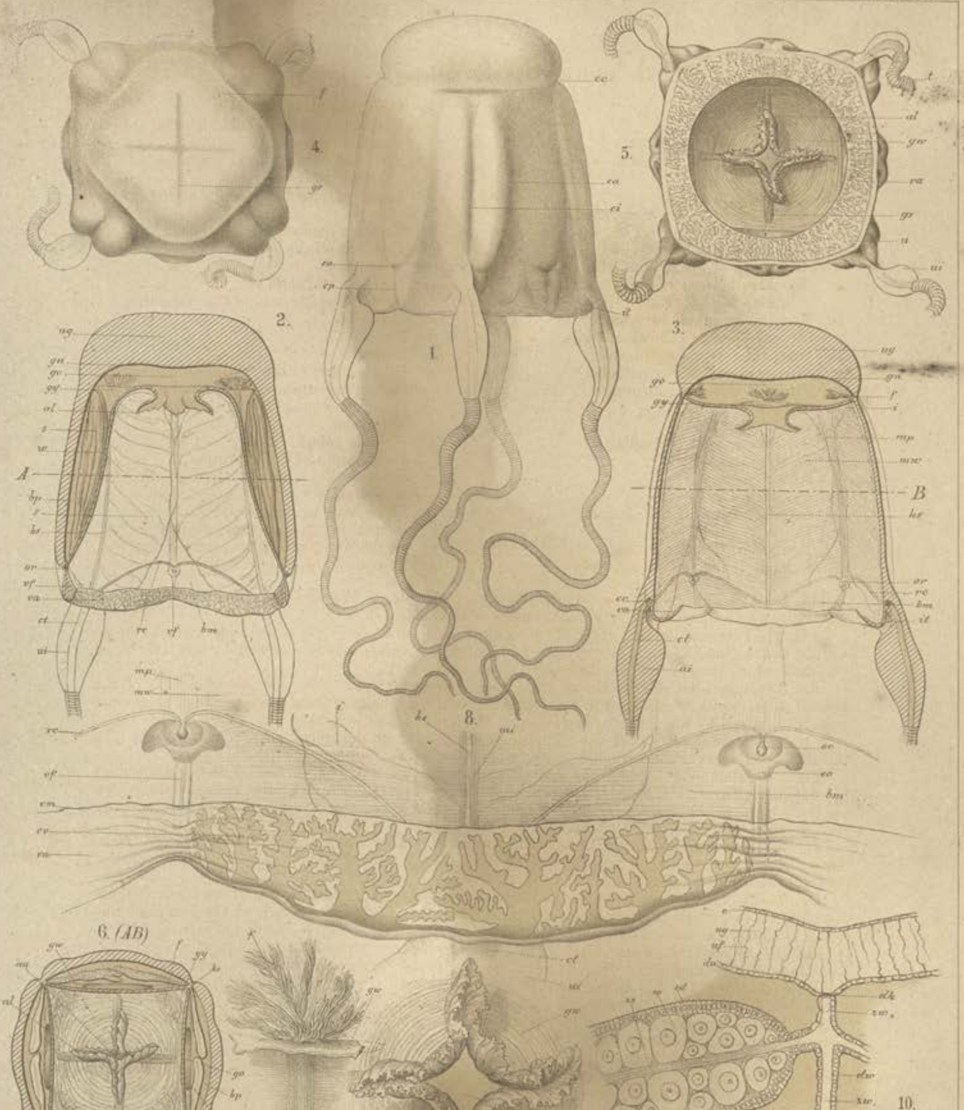
Fig. 6.—Transverse section through the umbrella, nearly in the middle of the height, from below, natural size. The four pairs of reproductive leaves (*s*) are visible in the opened radial pouches (*bp*) and the four gastral openings (*go*) in their bases.

Fig. 7.—A phacellus or bunch of filaments, slightly enlarged, consisting of a group of dendriform gastral filaments, which is placed upon an interradial pylorus valve in an angle of the bottom of the stomach. Below, a piece of the subumbral wall of the pouch (*w*) and of a cathammal septum (*ks*).

Fig. 8.—A quadrant of the velarium with the surrounding parts, seen from the subumbral side, four times the natural size. The velarium (*va*) with its dendriform canals is fastened by the perradial frenula (*vf*) to the subumbrella (*w*) and retroverted upwards. The nerve ring (*re*) rises in an arch from the sense niche (*eo*) to the interradial tentacle pedalium.

Fig. 9.—The oral cross with the four oral lobes, which are folded and thickly frilled, seen from below, three times the natural size.

Fig. 10.—Transverse section through a cathammal septum (*ks*) with the surrounding parts greatly enlarged. We see that the reproductive leaves run out from the subumbrella, on the axial side of the cathamma.



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CHARYBDEA MURRAYANA.

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PLATE XXVII.

NAUPHANTA CHALLENGERI.

Fig. 1.—The entire Medusa, from above, spread out flat (exumbral view), eight times the natural size. The inner half of the central umbrella disk is undivided, the outer half is divided into sixteen subradial swellings. The peripheric umbrella is divided by sixteen deep subradial furrows into sixteen gelatinous sockels or pedalia, of which the eight narrower (principal) bear the sense clubs, the eight broad (adradial) bear the tentacle.

Figs. 2–10.—Horizontal transverse section at different heights, indicated in fig. 14. (Pl. XXVIII.) by the numbers II.—X. The gelatinous substance or supporting plate of the umbrella is invariably coloured blue, the ovaries red, and the hollow space of the gastrovascular system yellow; eight times the natural size. From want of room only half of the sections are given. *h* Umbrella cavity. *i* Funnel cavity. *st* Supporting plate of the ovaries (sterigma). *so* Egg cells. *bo* Ocular pouches. *bt* Tentacle pouches. *dp* Endodermal folds of the subumbral wall of the ocular pouches. *mc* Coronal muscle. *w* Subumbrella. *gb* Basal stomach. *gc* Central stomach. *ga* Buccal stomach.

Fig. 2.—Transverse section through the basal stomach immediately above the septal nodes, at the height of the pyloric valves (*gi*). *f* Gastral filaments.

Fig. 3.—Transverse section through the central stomach at the height of the interradial cathamma or septal nodes (*ku*); the four broad horizontal gastral openings of the four perradial gastral pouches (*bp*) alternate with these. *ii* Interradial funnel cavities.

Fig. 4.—Transverse section through the coronal intestine, immediately below the coronal sinus, through the uppermost (proximal) part of the genitalia (*s*). Four broad interradial pouches (br_2) alternate with four narrow perradial ocular pouches (bo_1) from which, but somewhat deeper, the four interradial ocular pouches (bo_2) and the eight adradial tentacle pouches (*bt*) run out. Comp. fig. 5.

Fig. 5.—Transverse section through the coronal intestine, somewhat lower than the preceding. The eight wide adradial tentacle pouches (*bt*) containing the genitalia (*s*), alternate with the eight narrow ocular pouches (*bo*) and project, as if inflated, into the umbrella cavity (*h*). The supporting plates (*st*) of the two genitalia belonging to one pair, are rolled inwards so that their concavities are opposite one another.

Fig. 6.—Transverse section through the coronal intestine, somewhat above the coronal muscle. The supporting plate of the genitalia (sterigma *st*) springs from the subumbral wall of the eight adradial pouches (*bt*), apparently with a double root, as the simple root is crescentic and cut out concavely above (the section touches both horns of the crescent, comp. fig. 7).

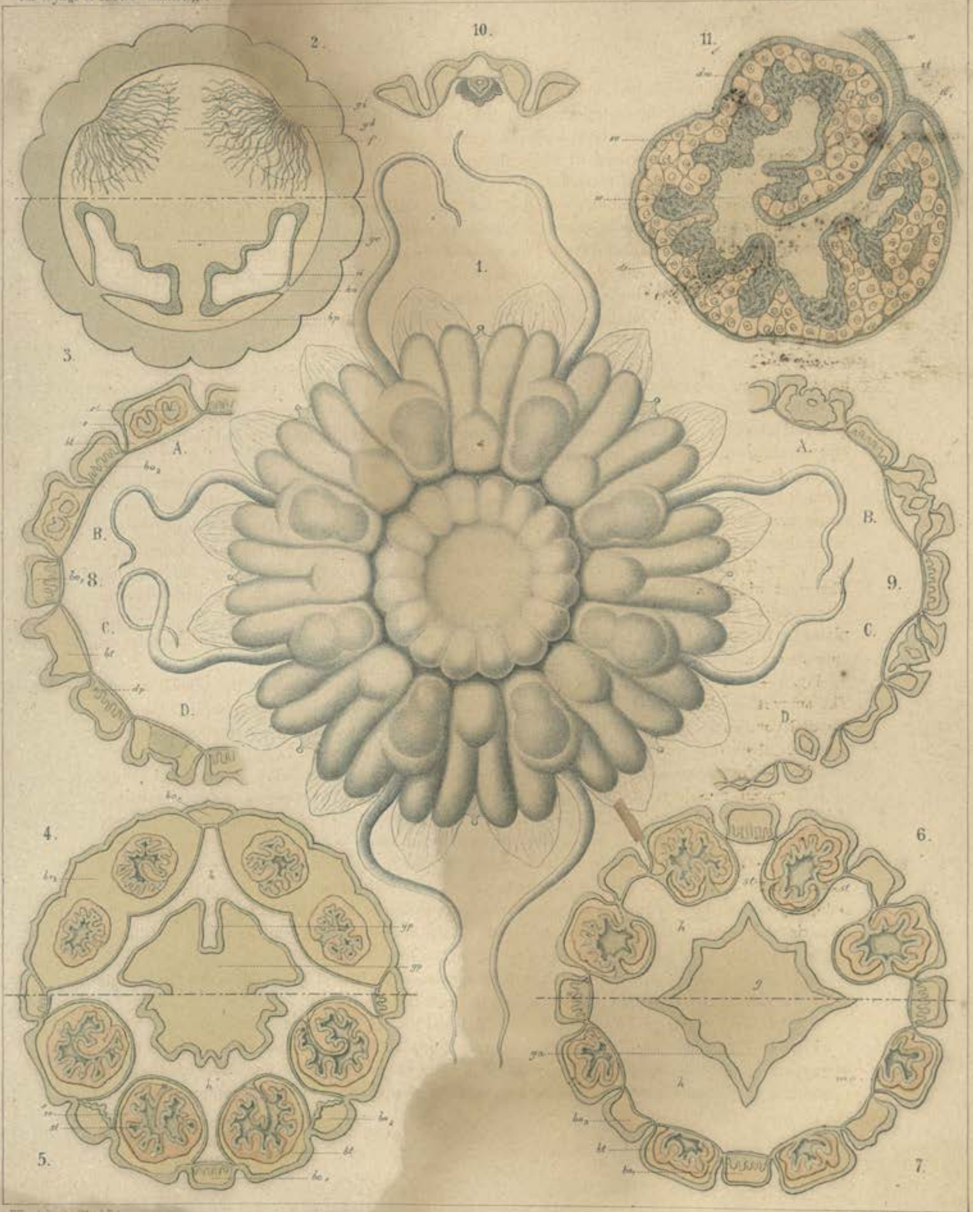
Fig. 7.—Transverse section through the coronal intestine, somewhat below the proximal margin of the coronal muscle (*mc*). The supporting plate of the genitalia (sterigma, *st*) springs with a simple root from the subumbral wall of the coronal muscle (*mc*). Of the eight ocular pouches only the four perradial are furnished with subumbral endodermal tufts.

Fig. 8.—Transverse section through the coronal intestine in the lower third of the coronal intestine (*mc*). All the eight ocular pouches (*bc*) are furnished with endodermal tufts. The section is taken obliquely so that the four pairs of tentacles, from above to below, correspond to four different heights or horizontal planes, lying one above the other. The distal ends of the genitalia are still visible in the two upper tentacle pouches (*A*, *B*) but not in the two lower (*C*, *D*).

Fig. 9.—Transverse section through the lobe corona at the base of the tentacle insertion. This section is also taken somewhat obliquely at four different heights (*A*–*D*).

Fig. 10—Transverse section through a sense club and the surronnding sense lobes (*lo*).

Fig. 11.—Transverse section through an ovary thirty times the natural size. *w* Subumbrella. *st* Supporting plate of the ovary (sterigma). st_1 Root of the sterigma. *so* Egg cells. *ds* Germinal epithelium of the endoderm. *dw* Subumbral endodermal epithelium on the free upper surface of the ovaries. *ss* Genital sinus.



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NAUPHANTA CHALLENGERI.

PLATE XXVIII.

NAUPHANTA CHALLENGERI.

The meaning of the letters is the same in all the figures.

aa	Mouth.
al	Oral lobes (perradial).
as	Oral cross (perradial).
bc	Coronal pouches.
bl	Lobe pouches.
bo	Ocular pouches (principal coronal pouches, four perradial and four interradial).
br	Radial pouches.
bt	Tentacular pouches (adradial coronal pouches).
cs	Coronal sinus.
ds	Endodermal germinal epithelium.
dw	Endoderm of the subumbrella.
ec	Coronal furrow of the exumbrella.
es	Radial furrows of the umbrella disk.
f	Gastral filaments.
ga	Buccal stomach.
gb	Basal stomach.
gc	Central stomach.
gi	Valves of the pylorus.
go	Gastral ostia.
gp	Palatine opening.
gy	Pyloric opening.
gw	Subumbral wall of the stomach.
h	Umbrella cavity.
i	Interradial funnel cavities.
kl	Subradial septa (fused clasps).
kn	Interradial septa (cathammal nodes or fused nodes).
l	Subradial marginal lobes.
lp	Selvedge of the marginal lobes (patagium).
mc	Coronal muscle.
mc_1	Proximal margin of the coronal muscle.
mc_4	Distal margin of the coronal muscle.
md'	Perradial deltoid muscles.
md"	Interradial deltoid muscles.
o	Sense clubs.
q	Ectoderm.
s'	Free proximal part of the genitalia.
s"	Veiled distal part (covered by the coronal muscle) of the genitalia.
sb	Follicle of the testis.
so	Egg cells.
ss	Genital sinus.
st	Sterigma (genital fulcral framework).
st'	Root of the sterigma.
t	Tentacles.
ua	Adradial pedalia (of the tentacles).
uc	Central disk of the umbrella.
ug	Gelatinous substance of the umbrella.
ui	Interradial ocular pedalia.
up	Perradial ocular pedalia.
w	Subumbrella.
z	Supporting plate (fulcral lamella).

Fig. 12.—The entire Medusa from below, spread out flat (subumbral view), eight times the natural size.

Fig. 13.—The entire Medusa, from the side (profile view), eight times the natural size (comp. fig. 1, Pl. XXVII.).

Fig. 14.—Interradial section through the entire Medusa, eight times the natural size.

Fig. 15.—Adradial section through an octant, twenty-five times the natural size, to show the sterigma (*st*) of the ovaries and the origin of its root (*st'*) from the umbrella. The genital sinus (*ss*) is lined by endodermal germinal epithelium (*ds*). The pyloric valves (*gi*) with the gastral filaments (*f*) are visible above at the pyloric opening.

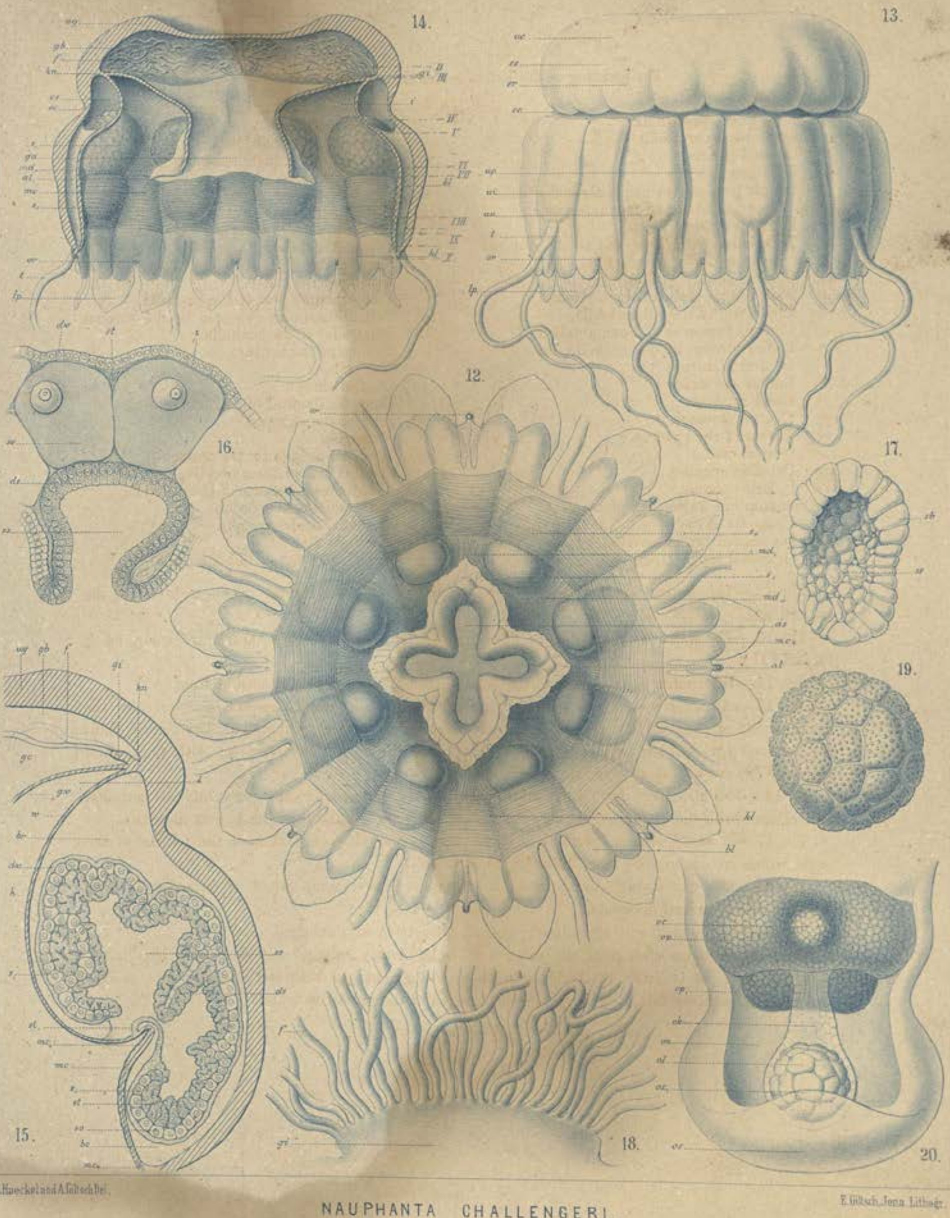
Fig. 16.—Radial section through an ovarial fold, greatly enlarged, to show the cylindrical germinal epithelium of the endoderm (*ds*) which produces the egg cells (*so*) and lines the genital sinus (*ss*).

Fig. 17.—A testis, sixteen times the natural size, to show the composition of the follicles of the testis, which are enclosed by a spacious genital sinus (*ss*).

Fig. 18.—A pyloric valve, along with the phacellus placed on it, which is formed by a bow-shaped series of gastral filaments.

Fig. 19.—An octant, with granulated polyhedric facets, greatly enlarged.

Fig. 20.—A sense club from the inner axial side, greatly enlarged. *oc* Eye (with lens ?). *ok* Auditory club. *ol* Otolite. *on* Auditory niche. *op* Pigment pad with tactile plate (*op'*). *os* Protective scale (auditory fold). *os'* Free inverted margin of the protective scale.



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NAUPHANTA CHALLENGERI.

PLATE XXIX.

ATOLLA WYVILLII.

The meaning of the letters is the same in all the figures.

aa	Oral opening.
ac	Oral columns (interradial).
al	Oral lobes.
am	Margin of the mouth.
bb	Buccal pouches (perradial).
bp	Perradial gastral pouches.
bt	Tentacular coronal pouches.
ck	Tentacular lobe canals.
co	Ocular canals (sense pouches).
ec	Coronal furrow of the exumbrella.
ec'	Thinnest part of the gelatinous substance of the umbrella.
cs	Coronal sinus.
ct	Tentacle canals.
cx	Adocular canals.
dg	Endodermal surface of the stomach.
er	Marginal teeth of the umbrella disk.
es	Marginal indentations of the umbrella disk.
f	Gastral filaments.
ga	Buccal stomach.
gb	Basal stomach.
gc	Central stomach.
gi	Pyloric valves.
go	Gastral openings.
gp	Palatine opening.
gw	Swellings of the subumbral gastral wall.
h	Umbrella cavity.
i	Funnel cavities.
kl	Fused clasps.
kt	Cathammal plates (septal plates).
l	Marginal lobes.
mc'	Thinner inner coronal muscle.
mc''	Thicker outer coronal muscle.
md'	Perradial deltoid muscle.
md''	Interradial deltoid muscle.
mk	Root muscles of the tentacles.
mt'	Abaxial tentacle muscle.
mt''	Axial tentacle muscle.
or	Rudimentary sense clubs.
q	Ectoderm.
s	Ovaries.
sa	Aperture of the genital sinus.
sq	Ova.
ss	Genital sinus.
st	Fulcral frame of the sterigma.
si	Basal root of the sterigma.
t	Tentacles.
uc	Central umbrella disk.
uo	Pedalia of the rhopalia.
ut	Pedalia of the tentacles.
w	Subumbrella.
wr	Mesenteries (perradial).
yu	Circular furrow on the subumbral wall of the coronal sinus.
zw	Supporting plate of the subumbrella.

Figs. 1 and 2 are natural size, the other figures twice the natural size.

Fig. 1.—Exumbral view of the entire Medusa (from above), natural size. The deep coronal furrow (*ec*) separates the indented umbrella margin (*uc*) from the corona of tentacle pedalia (*ut*) and sense pedalia (*uo*).

Fig. 2.—Subumbral view of the entire Medusa (from below), natural size. The eight ovaries (*g*) lie in pairs round the stomach, whose eight mesenteries separate the four pairs.

Fig. 3.—Subumbral view of the entire Medusa (from below), in four quadrants, twice the natural size. The first quadrant (to the right, below) gives the complete subumbral view, whilst the coronal muscle is removed in the three other quadrants. The corona of pouches is shown in the second quadrant (to the left, below), the deltoid muscles and tentacle muscles in the third quadrant (to the right, above). All the subumbral organs are removed in the fourth quadrant (to the left, above) to show the endodermal surface of the gelatinous substance of the umbrella. A pair of the eight genitalia is removed to the left above, a pair opened to the left below. The subumbral wall of the stomach is complete only to the right below.

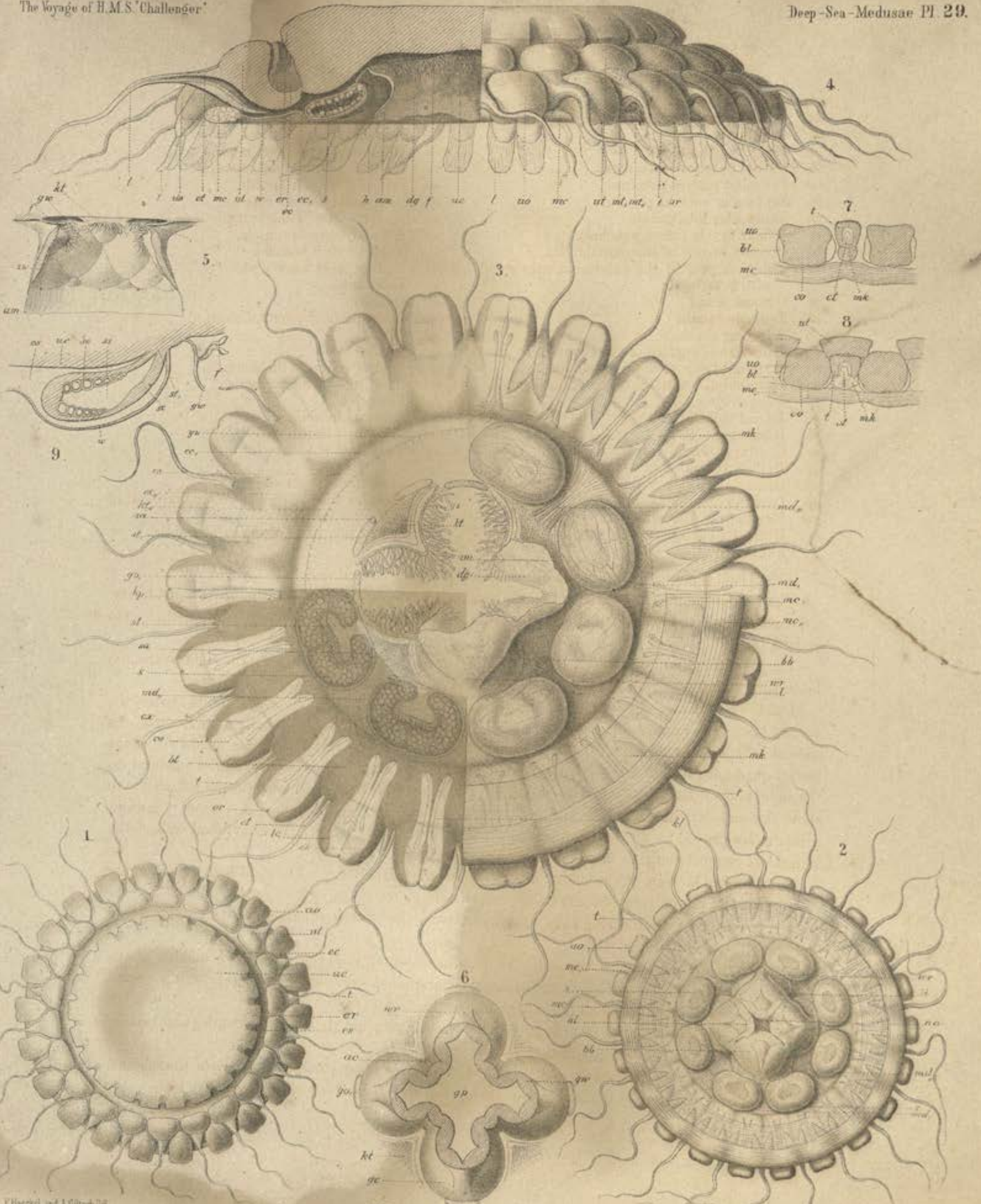
Fig. 4.—Profile view of the entire Medusa, twice the natural size. The right half of the figure shows the outer profile view, the left half, a radial section.

Fig. 5.—Radial section through the œsophagus, twice the natural size, to show the swellings (*gw*) and phacelli (*f*) on its inner wall.

Fig. 6.—Horizontal section through the palatine opening (*gp*) or constricted middle of the œsophagus, twice the natural size; the triangular interradial cathammal plates (*k*) project centripetally between the four perradial limbs of the cross.

Figs. 7–8.—Two tangential sections through a tentacle root and the two adjacent rhopalar pedalia (*uo*), twice the natural size; fig. 7 further out, fig. 8 further in.

Fig 9.—Radial section through an ovary and the surrounding coronal sinus, twice the natural size, showing the insertion of the sterigma (*st*) at the subumbral wall (*w*) of the coronal sinus (*cs*).



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ATOLLA WYVILLEI.

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PLATE XXX.

DRYMONEMA VICTORIA.

Fig. 1.—The entire Medusa, subumbral view, from below, in four quadrants, natural size. In the middle we see through the oral cross into the central stomach. The first quadrant (to the left, above) shows the repeatedly folded brachial curtains or the delicate, thin-membraned extensions of the oral arms, thickly frilled at the edges. The whole subumbral wall is removed in the upper half of the second quadrant (to the right, above) so as to show the upper (umbral) gelatinous wall of the dichotomously branched coronal pouches and lobe pouches, which are only separated by narrow, radial, cathammal ridges; the tentacles, which spring in large numbers between the dichotomous radial ribs of the subumbrella, are visible in the lower half of the second quadrant. The third quadrant (to the right, below) shows a complete gastrogenital pouch, which springs with a narrow, interradial base between every two perradial oral pillars; the frilled genital band is deeply inserted in the distal bottom of the repeatedly folded evagination of the fundus of the stomach. The tentacles are cut away at their base in the fourth quadrant (to the left, below) so that we merely see their insertion in the deep radial furrows (between the projecting dichotomous radial ridges of the subumbrella). The four sense niches are visible in the lower half of the figure; they lie far from the umbrella margin on the deep velar furrow, which separates the broad zone of tentacles from the marginal velarium (or zone of fused marginal lobes).

Figs. 2–7.—Different views of the sense clubs or rhopalia and the adjacent parts, enlarged.

Fig. 2.—A subumbral sense niche seen from below, slightly enlarged in the middle, the lanceolate sense niche (*on*). The sense club (*or*) lies hidden in the middle of the lanceolate sense niche (*on*), somewhat nearer its proximal margin; it is surrounded on either side by the labiate sense folds (*of*) which rise from the subumbrella (*w*).

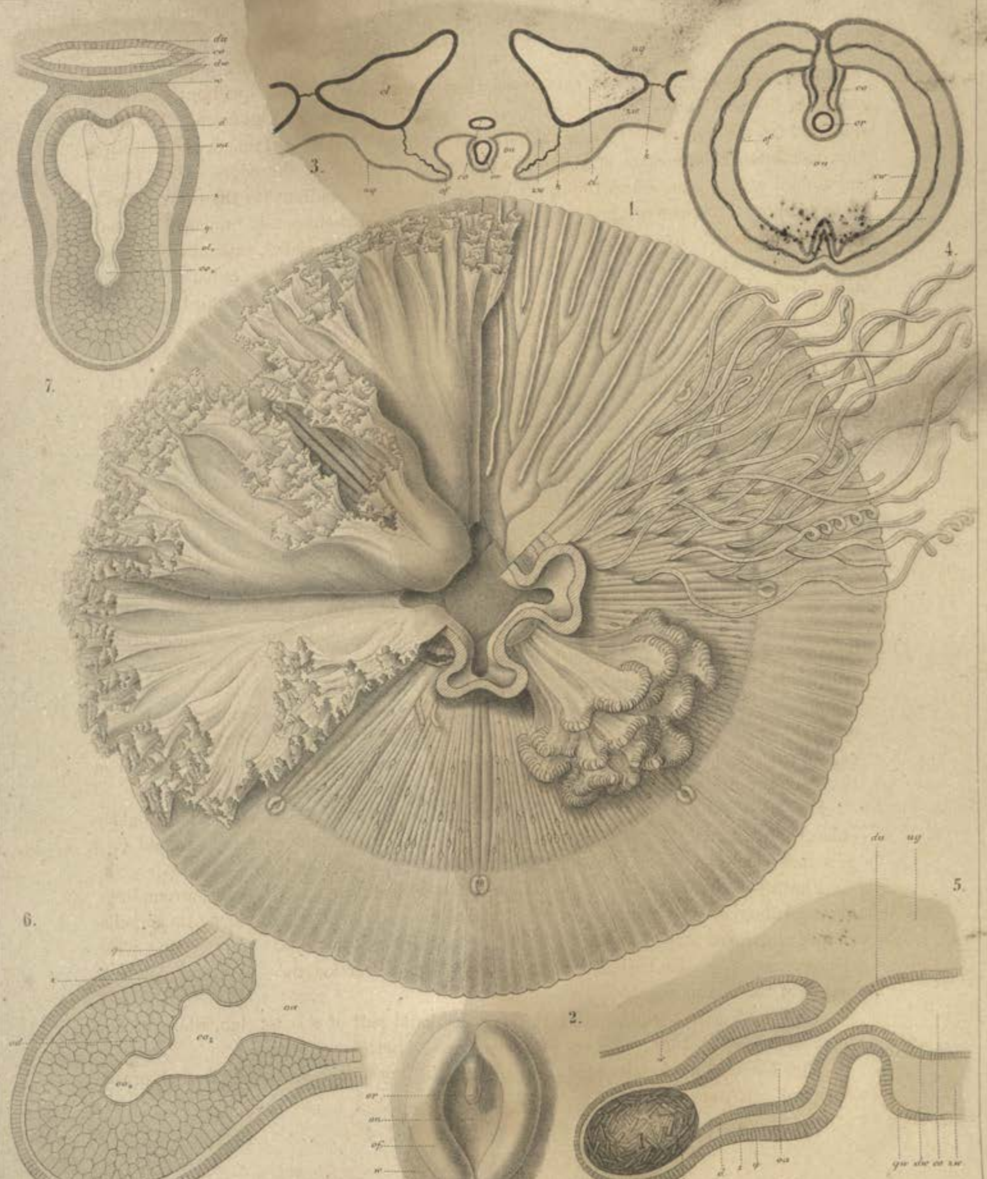
Fig. 3.—Vertical tangential section through a sense niche (*om*) slightly enlarged. *or* Sense club. *of* Sense folds. *co* Sense canal. *cl* Lobe canal. *ug* Gelatinous substance of the umbrella. *zw* Gelatinous substance of the subumbrella. *k* Cathamma between the subumbrella and exumbrella (fused plate). *wq* Ectoderm of the subumbrella.

Fig. 4.—Oblique section through a sense niche (*on*) from above and within, slightly enlarged. *k* Cathamma (fused suture between the subumbral (*zw*) and umbral (*ug*) gelatinous plate of the sense folds, *of*). *co* Canal of the sense club (*or*).

Fig. 5.—Vertical radial section through a sense club and its nearest surroundings, greatly enlarged. co_1 Sense canal. co_4 Blind distal end of the sense club, *oa* its ampulla-shaped enlargement. *ol* Otolites. *q* Ectoderm. *w* Subumbrella. *z* Supporting plate. *d* Endoderm. *du* Umbral endoderm. *dw* Subumbral endoderm. *ug* Gelatinous substance of the umbrella.

Fig. 6.—Vertical radial section through the distal part of a sense club, whose otolites have been dissolved by acid, very much enlarged. Letters as in fig. 5.

Fig. 7.—Oblique longitudinal section through a sense club, almost horizontal, greatly enlarged. Letters as in fig. 5.



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DRYMONEMA VICTORIA.

PLATE XXXI.

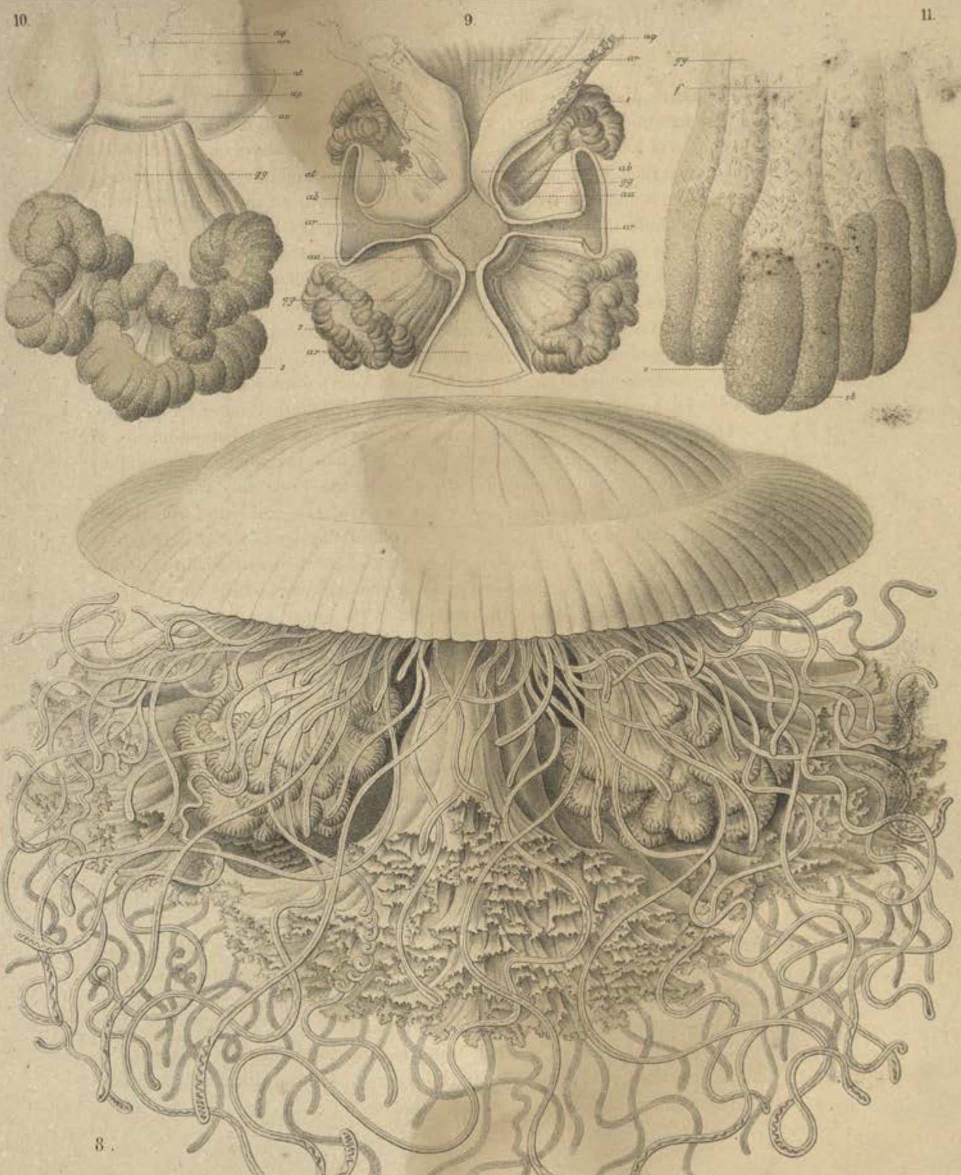
DRYMONEMA VICTORIA.

Fig. 8.—The entire Medusa, profile view (from the side and somewhat from above), natural size. The external velar furrow, which separates the central umbrella disk from the peripheric corona of lobes or velarium, is distinctly perceptible above on the umbrella. The eighty fused marginal lobes are visible on the velarium and the sixteen bifurcate radial streaks, forming a star-like figure, like that of *Chrysaora*, on the central umbrella disk. The powerful bush of oral curtains hangs down from the subumbrella, with the genitalia and tentacles outside it. The numerous tentacles are scattered all over the broad tentacle zone of the subumbrella, not grouped in eight bunches (as in the allied *Cyanea*). The four powerful perradial oral arms (or oral curtains) hang down from the peristom disk, like delicate, richly folded drapery, daintily frilled at the edges. The four interradial gastrogenital pouches, which are only half as long but are also folded like curtains, alternate with the oral arms. Only two of the pouches are visible in the figure; the frill-like folded genital band forms repeated windings in the bottom of the pouches.

Fig. 9.—The peristome disk with the central oral cross and the adjacent organs, of a young persona, seen from below, natural size. The four perradial oral arms (*ab*) alternate with the four interradial genitalia, of which the two lower only are completely visible, the two upper are half hidden under the bases of the oral arm: the frilled, repeatedly twisted genital band (*s*) lies below in the distal bottom of the thickly folded gastrogenital pouches (*gg*) whose proximal end is inserted at the cartilaginous oral ring (*au*). Only the basal piece of the four oral arms or arm curtains is visible in the figure and represented in such a way as to be fully visible on the upper arm, half cut away in the two middle arms, and removed for the most part in the lowest arm. The upper arm shows how the two diverging side margins of the strong, equilaterally triangular cartilaginous plate (which forms the basal part of the oral curtains and the distal extension of the brachial pillars) lie one over the other at one point (at *ab*) like valves, so that the shallow oral groove (*ar*) after a short course, is almost transformed into a canal. The lower valve (or the lower lateral margin of the triangular cartilaginous plate) is cut away, so that the oral groove (or arm groove) lies entirely open (*ar*). The latter is laid still more open on the lower arm, of which only the dorsal middle piece of the cartilaginous plate is preserved. Only a small basal piece (*aq*) of the delicately membraned, richly folded oral curtains, which run from the retroverted side margins of the basal cartilaginous plate, is visible; it shows, however, how the four oral curtains are connected below the oral ring (*au*) and form a short œsophagus (*at*).

Fig. 10.—A genitalium, with the adjacent oral part, from a mature female, natural size. *s.* The band-shaped ovary, folded like a frill. *gg* The delicate membraned gastrogenital pouch. *au* Cartilaginous ring. *ap* Perradial oral pillars. *at* Œsophagus. *am* Frilled margin of the oral curtains, retroverted upwards.

Fig. 11.—A small piece of a genital band (spermarium) slightly enlarged. *g* Follicles of the testis. *gg* Gastrogenital membrane. *f* Gastral filaments, scattered over its endodermal inner surface.



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DRYMONEMA VICTORIA

PLATE XXXII.

LEONURA TERMINALIS.

The letters have the same meaning in all the figures.

a	Oral opening (fused).
ab	Oral arms.
ah	Oral disk (brachial disk).
an	Funnel frills (sucking frills).
ao	Frill mouths (sucking mouths).
ap	Brachial pillars (oral pillars).
as	Oral cross (fused).
ca	Adradial subumbral canal.
cc	Circular canal.
cd	Pillar canals (perradial).
ch	Brachial canals (adradial).
ci	Interradial subumbral canals.
cp	Perradial subumbral canals.
cv	Velar canals (lobe canals).
ga	Buccal stomach.
gc	Central stomach.
gg	Gastrogenital membrane.
gh	Cross of the gastrogenital membrane.
gm	Margin of the central stomach.
ig	Subgenital openings (portale).
ir	Subgenital porticus.
lo	Ocular lobes.
lv	Velar lobes.
o_1	Perradial rhopalia.
o_2	Interradial rhopalia.
g	Genitalia (genital frills).
gx	Distal ends of the genitalia.
ug	Gelatinous substance of the umbrella.
w	Subumbrella.
z	Supporting plate (fultura).

With exception of figs. 5 and 8 all the figures are drawn in natural size.

Fig. 1.—The entire Medusa, profile view (from the side), natural size. To the right, an octant of the velarium is cut away, to show a subgenital ostium (*ig*), bounded on either side by an oral pillar (*ap*).

Fig. 2.—Radial section through the entire Medusa, natural size. The umbrella is only connected with the brachiferous disk (*ah*) by the perradial oral pillars (*ap*). The central stomach (*gc*), from which the radial canals run out, is also only connected by the four pillar canals (*cd*), with the buccal stomach (*ga*) from which the eight brachial canals diverge.

Fig. 3.—The entire Medusa, exumbral view, from above, natural size. The cruciate central stomach, with the genital cross, shines through the umbrella, which appears divided into polygonal areæ; twice the natural size. The eight sense clubs are visible on the margin.

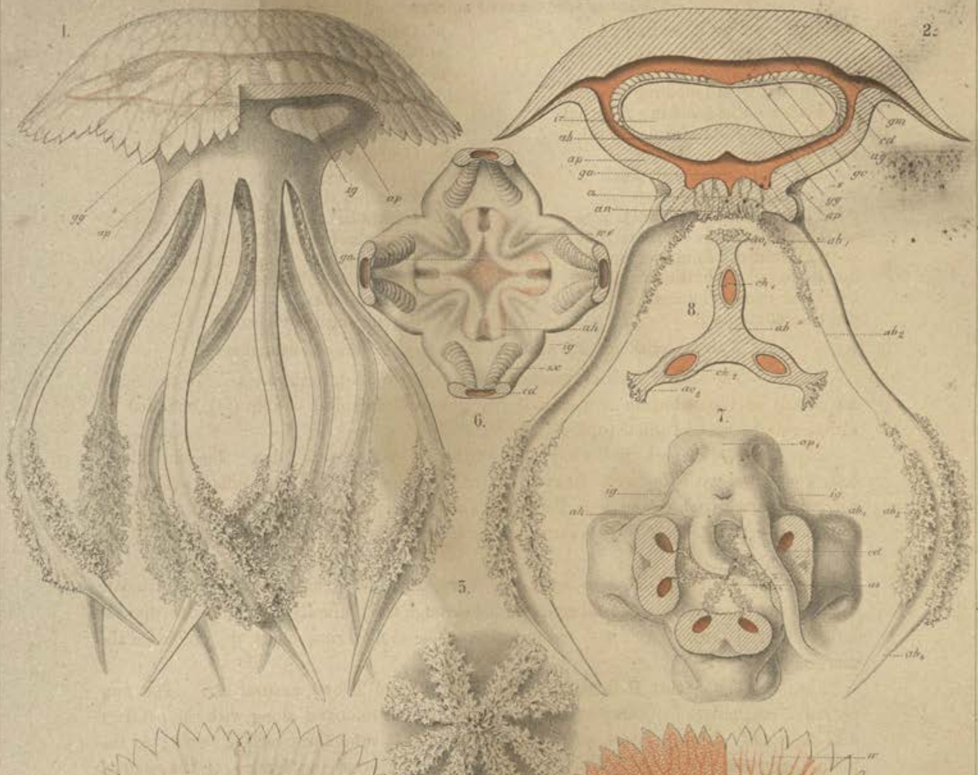
Fig. 4.—The entire Medusa, subumbral view (from below), natural size. The four perradial oral pillars (*ap*) are cut away at the base and removed along with the pendant oral disk, and the eight arms, so as to show the whole subumbral surface freely; in the middle the cruciate gastrogenital membrane (which forms the fundus of the central stomach).

Fig. 5.—Rosette of tufts of the oral disk, in the middle of its ventral surface, from below; twice the natural size; the eight adradial limbs of the disk hang in pairs from its base.

Fig. 6.—The dorsal surface of the oral disk, from above, natural size; the buccal stomach (*ga*) shines through in the middle. Sections through the four pillar canals (*cd*) are shown at the four perradial angles, with the distal end of the genitalia (*gx*) on either side.

Fig. 7.—The ventral surface of the oral disk, from below, natural size. Three of the four pair of arms are cut away at the base; the rosette of tufts in the middle is removed, to show the fused suture of the oral cross (*ao*).

Fig. 8.—Transverse section through an arm, at the beginning of the formation of the frills, slightly enlarged. an_1 Ventral (unpaired) frill. an_2 Dorsal (paired) frills. ch_1 Ventral (unpaired) brachial canal. ch_2 Dorsal (paired) brachial canals.



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LEONURA TERMINALIS.

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the HOLOTHURIOIDEA dredged by H.M.S. Challenger during the years 1873-1876. By HJALMAR THÉEL. Part I.

INTRODUCTION.

WHEN, at the request of Sir Wyville Thomson, F.R.S., I undertook to work out the HOLOTHURIOIDEA dredged during the Challenger Expedition, I had not the least idea of the value and richness of the material confided to my care. But the first inspection made it evident that the forms from great depths, now displayed for the first time, were of the greatest interest by making it manifest that Holothurians are living there not merely in great numbers but belonging to many species, and that a large majority of them present certain peculiarities that render them strikingly different from the littoral forms hitherto known, and make them constitute perhaps the most characteristic group of the whole abyssal fauna. As will be seen further on, I have considered myself justified in placing them under a new order—*Elasipoda*,[1] equivalent to the *Pedata* and *Apoda* already known. Of that order I shall here give the systematic and anatomical description.

During the Swedish expedition to the Yenisei, in the year 1875, several specimens of a singular animal were found in the Kara Sea, on the north-east coast of Novaya Zemlya. On a closer examination it was found to be a Holothurid, which I have described[2] under the name of *Elpidia*, the single representative of a new family, the Elpidiidæ.

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[1] This seems a more correct name than "Elasmopoda" used in the Preliminary Report.

[2] Memoire sur l'Elpidia, nouveau genre d'Holothuries. Avec cinq Planches. Présenté à l'Académie Royale des Sciences le 8 Mars 1876. Kongl. Svenska Vetenskaps-Akademiens Handlingar, Bandet 14, No. 8, Stockholm, 1877.

This discovery was the introduction to the knowledge of the order Elasipoda. The Norwegian Atlantic Dredging Expeditions, from 1876–1878, also brought home from the extreme depths of the North Atlantic two curious forms, *Irpa*[1] and *Kolga*,[2] which have been most carefully described by Danielssen and Koren, and considered by them as belonging to the same family as *Elpidia*.

The obscurity which involved the abyssal fauna was first fully dispelled by the dredgings during the Challenger expedition; and honour is due to its scientific staff, but above all to its director, Sir C. Wyville Thomson, F.R.S., for having brought to light numerous forms hitherto unimagined, equally surprising in outer form and inner organisation. While hitherto only three Elasipoda were known, this report contains descriptions of no less than fifty-two species and three varieties, divided into nineteen genera. Besides the three forms before mentioned, sixteen were described in the Preliminary Report on the Holothuridæ of H.M.S. Challenger.[3]

The Elasipoda are true deep-water forms, and they may with all the more reason be said to characterise the abyssal fauna, as no single representative, as far as at present known, has been found to exist at a depth less than 50 fathoms. Only one form, viz., *Elpidia glacialis*, Théel, has been dredged at this inconsiderable depth; but then I would point out that this was found in the Arctic Ocean, where it may be supposed that deep-sea forms are able to live at a comparatively trifling depth. *Elpidia glacialis*, Théel, at the same time appears to be a true abyssal form, and capable of existing at a great variety of depths. One specimen was, for instance, found living at a depth of 900 fathoms near the coast of Greenland, and a great number of individuals were dredged during the Norwegian Expeditions in the North Atlantic, at considerable depths; and finally, the Challenger Expedition brought home an individual dredged from Station 160, at a depth of 2600 fathoms.

A glance at the list given below will show that four species only are found at depths varying from 50 to 500 fathoms, and as many from 500 to 1000 fathoms, but that all the rest are obtained from dredgings exceeding 1000 fathoms. Thus we learn that the Elasipoda abound over the floor of the ocean at great depths, and that the number of species and of individuals is greatly reduced shorewards. The greatest depth at which any living Holothurid has been obtained is 2900 fathoms.

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[1] Echinodermer fra den Norske Nordhavsexpedition. Nyt Magazin for Naturvidenskaberne, 24-de Binds 3 Hefte, Christiania, 1877.

[2] Echinodermer fra den Norske Nordhavsexpedition. Nyt Magazin for Naturvidenskaberne, 25-de Binds 2-det Hefte, Christiania, 1879.

[3] Bihang till Kongl. Svenska Vet. Akad. Handlingar, Band 5, No. 19, Stockholm, 1879.

LIST OF SPECIES FOUND IN DEPTHS FROM 50 TO 2000 FATHOMS.

Depth in Fathoms.	
50–150	*Elpidia glacialis*, Théel.
95–100, 129, 150	*Ilyodæmon maculatus*, Théel.
345	*Lætmogone wyville-thomsoni*, Théel.
450	*Orphnurgus asper*, Théel.
555, 950	*Lætmogone violacea*, Théel.
565	*Lætmogone spongiosa*, Théel.
700, 950	*Pannychia moseleyi*, n. sp.
900	*Elpidia glacialis*, Théel.
1050	*Irpa abyssicola*, Danielssen & Koren.
1090	*Benthodytes typica*, n. sp.
1090, 1375	*Euphronides depressa*, n. sp.
1100	*Enypniastes eximia*, n. sp.
1100, 1200	*Kolga hyalina*, Danielssen & Koren.
1250, 1260	*Kolga nana*, Théel.
1260	*Scotoplanes murrayi*, Théel.
1260	*Elpidia incerta*, n. sp.
1375	*Psychropotes lovéni*, n. sp.
1375, 1400	*Benthodytes papillifera*, n. sp.
1375, 1950	*Oneirophanta mutabilis*, Théel.
1375, 1600, 1800	*Lætmogone wyville-thomsoni*, Théel.
1450	*Peniagone vitrea*, n. sp.
1500	*Benthodytes mamillifera*, n. sp.
1500	*Benthodytes sanguinolenta*, n. sp.
1600	*Peniagone affinis*, n. sp.
1600	*Achlyonice lactea*, n. sp.
1600, 1950	*Elpidia purpurea*, n. sp.
1800	*Benthodytes sanguinolenta*, var. *marginata*, n.
1800	*Peniagone challengeri*, n. sp.
1800	*Peniagone naresi*, n. sp
1800, 1950, 1975	*Benthodytes sordida*, n. sp.
1900	*Psychropotes semperiana*, n. sp.
1900	*Scotoplanes albida*, n. sp.
1950	*Elpidia ambigua*, n. sp.
1950	*Scotoplanes globosa*, Théel.
1950	*Scotoplanes robusta*, n. sp.
1950	*Peniagone horrifer*, n. sp.
1950	*Psychropotes longicauda*, var. *monstrosa*, n.
1950	*Psychropotes longicauda*, var. *fusco-purpurea*, n.
1950, 1975	*Psychropotes longicauda*, n. sp.
1975	*Elpidia willemoësi*, n. sp.
1975	*Scotoplanes insignis*, n. sp.
2000	*Deima fastosum*, Théel.

LIST OF SPECIES OBTAINED FROM DEPTHS EXCEEDING 2000 FATHOMS.

Depth in Fathoms.	
2050	*Deima validum*, Théel.
2160	*Parelpidia elongata*, Théel.
2160	*Elpidia verrucosa*, Théel.
2160	*Scotoplanes globosa*, Théel.
2160, 2225	*Benthodytes mamillifera*, n. sp.
2160, 2300, 2385, 2600, 2650, 2900	*Oneirophanta mutabilis*, Théel.
2225	*Parelpidia cylindrica*, n. sp.
2225	*Benthodytes sordida*, n. sp.
2225	*Benthodytes sanguinolenta*, n. sp.
2225	*Benthodytes abyssicola*, n. sp.
2225	*Psychropotes longicauda*, n. sp.
2300	*Elpidia rigida*, n. sp.
2300	*Achlyonice paradoxa*, Théel.
2425	*Peniagone wyvillii*, n. sp.
2425	*Benthodytes papillifera*, n. sp.
2500	*Peniagone lugubris*, n. sp.
2500	*Psychropotes semperiana*, n. sp.
2600	*Elpidia glacialis*, Théel.
2600	*Scotoplanes globosa*, Théel.
2600	*Scotoplanes mollis*, Théel.
2600	*Peniagone atrox*, n. sp.
2600	*Scotoanassa diaphana*, n. sp.
2600	*Benthodytes sanguinolenta*, var. *marginata*, n.
2650	*Scotoplanes papillosa*, Théel.
2750	*Benthodytes selenkiana*, n. sp.
2750	*Psycheotrephes exigua*, n. sp.

With regard to the geographical distribution of the Elasipoda, it must be noted that our information with respect to it is too defective, and the number of deep-sea dredgings even now too small to admit of any general results being attained. However, it will be apparent from the following list that the Elasipoda are distributed throughout all seas. Some of them are very widely distributed over the bottom of the deep sea. *Elpidia glacialis*, Théel, is found in the Arctic Ocean and in the North Atlantic, in addition to which one individual has been brought home from Station 160, south of Australia. *Lætmogone violacea*, Théel, was dredged by the Challenger Expedition, close to Sydney, and during the cruise of the "Knight Errant" between the Faroe Islands and the coasts of Scotland in the summer of 1880, Mr Murray brought home more than a hundred specimens. It cannot be doubted that those two almost antipodal forms will be found at many interjacent localities when a larger area of the oceanic abysses has been explored. Of all the Elasipoda *Oneirophanta mutabilis* seems to have the widest distribution and occurs without doubt all round the world; it has been obtained from the South Atlantic Ocean, Station 325; from the South Indian Ocean, Stations 146, 157, an

160; from the South Pacific Ocean, Stations 281 and 299, and from the North Pacific Ocean, Stations 241 and 244.

GEOGRAPHICAL DISTRIBUTION OF THE ELASIPODA.

NORTH ATLANTIC OCEAN.

STATION V.—Lat. 35° 47′ N., long. 8° 23′ W. Depth, 1090 fms. Mud.
Benthodytes typica, n. sp.
Euphronides depressa, n. sp.

STATION 23.—Off Sombrero Island. Depth, 450 fms. Globigerina ooze.
Orphnurgus asper, Théel.

STATION 50.—Lat. 42° 8′ N., long. 63° 39′ N. Depth, 1250 fms. Grey ooze.
Kolga nana, Théel.

STATION 101.—Lat. 5° 48′ N., long. 14° 20′ W. Depth, 2500 fms. Mud.
Psychropotes semperiana, n. sp.

STATION 104.—Lat. 2° 25′ N., long. 20° 1′ W. Depth, 2500 fms. Grey ooze.
Peniagone lugubris, n. sp.

SOUTH ATLANTIC OCEAN.

STATION 133.—Lat. 35° 41′ S., long. 20° 55′ W. Depth, 1900 fms. Globigerina ooze.
Psychropotes semperiana, n. sp.

STATION 325.—Lat. 36° 44′ S., long. 46° 16′ W. Depth, 2650 fms. Grey mud.
Scotoplanes papillosa, n. sp.
Oneirophanta mutabilis, Théel.

SOUTH INDIAN OCEAN.

STATION 143.—Lat. 36° 48′ S., long. 19° 24′ E. Depth, 1900 fms. Globigerina ooze.
Scotoplanes albida, n. sp.

STATION 146.—Lat. 46° 46′ S., long. 45° 31′ E. Depth, 1375 fms. Globigerina ooze.
Psychropotes lovéni, n. sp.
Oneirophanta mutabilis, Théel.

STATION 147.—Lat. 46° 16′ S., long. 48° 27′ E. Depth, 1600 fms. Globigerina ooze.
Elpidia purpurea, n. sp.
Peniagone affinis, n. sp.
Achlyonice lactea, n. sp.
Lætmogone wyville-thomsoni, Théel.

STATION 152.—Lat. 60° 52′ S., long. 80° 20′ E. Depth, 1260 fms. Diatom ooze.
Elpidia incerta, n. sp.
Scotoplanes murrayi, Théel.

STATION 156.—Lat. 62° 26′ S., long. 95° 44′ E. Depth, 1975 fms. Diatom ooze.
Elpidia willemoesi, n. sp.
Scotoplanes insignis, n. sp.
Benthodytes sordida, n. sp.
Psychropotes longicauda, n. sp.

STATION 157.—Lat. 53° 55′ S., long. 108° 35′ E. Depth, 1950 fms. Diatom ooze.
Elpidia purpurea, n. sp.
Elpidia ambigua, n. sp.
Scotoplanes globosa, Théel.
Scotoplanes robusta, n. sp.
Peniagone horrifer, n. sp.
Benthodytes sordida, n. sp.
Psychropotes longicauda, n. sp.
Psychropotes longicauda, var. *monstrosa*, n.
Psychropotes longicauda, var. *fusco-purpurea*, n.
Oneirophanta mutabilis, Théel.

STATION 158.—Lat. 50 1′ S., long. 123° 4′ E. Depth, 1800 fms. Globigerina ooze.
Peniagone naresi, n. sp.
Peniagone challengeri, n. sp.
Benthodytes sordida, n. sp.
Benthodytes sanguinolenta, var. *marginata*, n.
Lætmogone wyville-thomsoni, Théel.

STATION 160.—Lat. 42° 42′ S., long. 134° 10′ E. Depth, 2600 fms. Red clay.
Elpidia glacialis, Théel.
Scotoplanes mollis, n. sp.
Peniagone atrox, n. sp.
Scotoanassa diaphana, n. sp.

Benthodytes sanguinolenta, var. *marginata*, n.
Oneirophanta mutabilis, Théel.

AUSTRALIA, NEW ZEALAND, AND THE EASTERN ARCHIPELAGO SOUTH OF THE EQUATOR.

STATION 164.—Lat. 34° 8′, long. 152° 0′ E. Depth, 950 fms. Grey ooze.
Lætmogone violacea, Théel.
Pannychia moseleyi, n. sp.

STATION 168.—Lat. 40° 28′ S., long. 177° 43 E. Depth, 1100 fms. Grey ooze.
Enypniastes eximia, n. sp.

STATION 169.—Lat. 37° 34′ S., long. 179° 22′ E. Depth 700 fms. Grey ooze.
Pannychia moseleyi, n. sp.

STATION 184.—Lat. 12° 8′ S., long. 145° 10′ E. Depth, 1400 fms. Grey ooze.
Benthodytes papillifera, n. sp.

STATION 192.—Lat. 5° 42′ S., long. 132° 25′ E. Depth, 129 fms. Mud.
Ilyodæmon maculatus, Théel.

STATION 219.—Lat. 1° 50′ S., long. 146° 42′ E. Depth, 150 fms. Mud.
Ilyodæmon maculatus, Théel.

SOUTH PACIFIC OCEAN.

STATION 271.—Lat. 0° 33′ S., long. 151° 34′ W. Depth, 2425 fms. Globigerina ooze.
Peniagone wyvillii, n. sp.
Benthodytes papillifera, n. sp.

STATION 274.—Lat. 7° 25′ S., long. 152° 15′ W. Depth, 2750 fms. Radiolarian ooze.
Benthodytes selenkiana, n. sp.
Psycheotrephes exigua, n. sp.

STATION 281.—Lat. 22° 21′ S., long. 150° 17′ W. Depth, 2385 fms. Red clay.
Oneirophanta mutabilis, Théel.

STATION 295.—Lat. 38° 7′ S., long. 94° 4′ W. Depth, 1500 fms. Red clay.
Benthodytes mamillifera, n. sp.
Benthodytes sanguinolenta, n. sp.

STATION 298.—Lat. 34° 7′ S., long. 73° 56′ W. Depth, 2225 fms. Grey mud.
Parelpidia cylindrica, n. sp.
Benthodytes mamillifera, n. sp.
Benthodytes sordida, n. sp.
Benthodytes sanguinolenta, n. sp.
Benthodytes abyssicola, n. sp.
Psychropotes longicauda, n. sp.

STATION 299.—Lat. 33° 31′ S., long. 74° 43′ W. Depth, 2160 fms. Grey mud.
Parelpidia elongata, Théel.
Elpidia verrucosa, Théel.
Scotoplanes globosa, Théel.
Benthodytes mamillifera, n. sp.
Oneirophanta mutabilis, Théel.

STATION 300.—Lat. 33° 42′ S., long. 78° 18′ W. Depth 1375 fms. Globigerina ooze.
Benthodytes papillifera, n. sp.
Lætmogone wyville-thomsoni, Théel.

STATION 302.—Lat. 42° 43′ S., long. 82° 11′ W. Depth, 1450 fms. Globigerina ooze.
Peniagone vitrea, n. sp.

NORTH PACIFIC OCEAN.

STATION 241.—Lat. 35° 41′ N., long. 157° 42′ E. Depth, 2300 fms. Red clay.
Elpidia rigida, n. sp.
Achlyonice paradoxa, Théel.
Oneirophanta mutabilis, Théel.

STATION 244.—Lat. 35° 22′ N., long. 169° 53′ E. Depth, 2900 fms. Red clay.
Oneirophanta mutabilis, Théel.

STATION 246.—Lat. 36° 10′ N., long. 178° 0′ E. Depth, 2050 fms. Grey ooze.
Deima validum, Théel.

EASTERN ASIA, INCLUDING CHINA, JAPAN, AND THE EASTERN ARCHIPELAGO NORTH OF THE EQUATOR.

STATION 209.—Lat. 10° 10′ N., long. 123° 55′ E. Depth, 95 to 100 fms. Mud.
Ilyodæmon maculatus, Théel.

STATION 216.—Lat. 2° 56′ N., long. 134° 11′ E. Depth, 2000 fms. Globigerina ooze.
Deima fastosum, Théel.

STATION 232.—Lat. 35° 11′ N., long. 139° 28′ E. Depth, 345 fms. Sandy mud.
Lætmogone wyville-thomsoni, Théel (?).

STATION 235.—Lat. 34° 7′ N., long. 138° 0′ E. Depth, 565 fms. Mud.
Lætmogone spongiosa, Théel.

It is evident that some of the Elasipoda, living together in great multitudes, pass along the bottom of the sea; this seems especially to be the case with *Lætmogone wyville-thomsoni* and *L. violacea*, *Oneirophanta mutabilis*, several species of the genus *Benthodytes*, *Kolga nana*, *Scotoplanes globosa*, &c., of which great numbers have sometimes been dredged at the same station. But numerous different species were also found together; thus, no less than ten forms were obtained from Station 157, five from Station 158, six from Station 160, six from Station 298, &c. The nature of the bottom of the sea is doubtless of great importance in regulating the distribution of the abyssal Holothurioidea, and they are found most numerous, and in greatest abundance, on a bottom of red clay, globigerina ooze, or diatom ooze.

DESCRIPTION OF THE SPECIES.

Order ELASIPODA.

Body bilateral, more or less distinctly symmetrical. The lateral ambulacra of the ventral surface, with larger and smaller mostly non-retractile pedicels, disposed in a single row, or rarely in two rows, and sometimes with another series of elongated conical, commonly non-retractile processes placed externally and above the pedicels; pedicels of the lateral ambulacra symmetrically arranged, being more or less distinctly opposed across the ventral surface. The odd ambulacrum naked, or with a few minute pedicels, or with a double row of such. The dorsal surface provided with very long, elongated conical, non-retractile processes, often disposed in one or more rows along each of its ambulacra, or with only a few rudimentary ones in its anterior part; or with a single, very large, broad, and more or less flattened, branched or unbranched appendage, crossing the odd interambulacrum, and some minute processes. Integument with plates, wheels, and branched or simple spicula; ambulacral vessels five; polian vesicle single, rarely two; madreporic canal single, dorsal, either intimately united to the perisoma in the medio-dorsal line, its extremity being invested by a calcareous network or not, or piercing the body-wall, and communicating with the exterior by one or several pores. The madreporic canal never depends freely into the peritoneal cavity. Ambulacral vesicles often transformed into large branched or unbranched cavities lying within the perisoma. Calcareous ring incompletely developed, either composed of a continuous, very fragile, network, without any distinct radial and inter-radial pieces, or mostly of five radial spicule-shaped pieces. Respiratory trees, ciliated cups, and retractor muscles absent. Sexes distinct.

This order is divided into three families—Elpidiidæ, Deimatidæ, and Psychropotidæ. The latter differs considerably from the two former in the shape of the body, which approximates often in general appearance to that of certain Aspidochirotæ; the presence of a more or less distinct margin round the body gives it a rather depressed aspect, and the head portion of the representatives of this family is generally considerably flattened—almost discoidal. The completely ventral position of the mouth, the arrangement of the comparatively minute pedicels in a single row round the above-mentioned brim, the presence of a double row of pedicels along the odd ambulacrum, &c., may be considered as characters which give the Psychropotidæ the right of being placed side by side with the two other families. Particular attention must be paid to the lateral pedicels, which are more numerous in the Psychropotidæ, and either small and retractile, or resembling more or less prominent protuberances, while those in the Elpidiidæ and Deimatidæ are as a rule large, wide, cylindrical, and non-retractile; besides, in both of these families the tentacles are very seldom capable of being drawn within the body, and their dorsal processes, mostly of considerable length, are often symmetrically arranged in pairs. The Elpidiidæ differ from the others in having the calcareous ring constantly composed of only five radial spicula, while in the other families it seems to be made up of a fragile net-work. The Deimatidæ are distinguished from the Elpidiidæ by their dorsal processes being more numerous, generally longer, densely crowded, and arranged in one or several continuous rows along the dorsal ambulacra; by their generally more elongated body, by the form of the calcareous deposits, by the number of the tentacles, &c. The Elpidiidæ have, with but few exceptions, ten tentacles, and the perisoma is always strengthened by branched or unbranched spicula.

Family I. ELPIDIIDÆ.

Body varying greatly in shape from very long, cylindrical, and Synapta-shaped, to rather short, almost globular, or strongly depressed, nearly flat; tentacles as a rule ten, in a few forms eleven to twelve or twenty; mouth seldom completely ventral, usually almost terminal, though more or less distinctly turned towards the ventral surface; the lateral ambulacra of the ventral surface bearing long and wide, cylindrical or conical, slightly retractile pedicels, disposed in a single row all along each side of that surface, or round its posterior half, or only on the margin of a brim surrounding the hindmost extremity of the body; the odd ambulacrum naked; the dorsal surface with a smaller number of sometimes very long, sometimes rather short or nearly rudimentary processes commonly disposed on its anterior part, or with a large branched or unbranched lobe-like appendage, situated anteriorly or forming a brim round the foremost extremity of the body; calcareous deposits; straight or slightly curved, C-shaped and horseshoe-shaped spicula, three- or four- armed bodies, more seldom a few minute, net-like plates, minute wheels, rosette-shaped or elliptical bodies; calcareous ring composed of only five spicule-shaped pieces, each consisting of a number of long, slender rods, diverging in opposite directions from a small central part.

This family presents a great number of forms of the most variable appearance. At first sight it seems almost impossible to comprise under the same family two genera so different from one another in their external appearances as, for instance, *Parelpidia* and *Peniagone*, but, after comparing all the thirty-one forms with one another, those scruples vanish totally, and give place, on the contrary, to some difficulty in finding satisfactory generic characters. The interval between those two extreme forms is filled up by such a series of gradations as to make a strict definition of the genera rather troublesome.

In defining the genera of this family, we have in the first place to consider the number of the tentacles, which, as characteristic of the family, may be regarded as being ten, only three forms being exceptions to this rule: *Enypniastes eximia*, *Achlyonice paradoxa*, and *Achlyonice lactea*, the first of which has about twenty tentacles, and the two latter only eleven or twelve. *Enypniastes* being an extremely characteristic form, and greatly different from the other genera of this family, I have felt somewhat doubtful with regard to its place in the system; its unexpectedly great number of tentacles, and several other peculiarities indicate a closer alliance with the family Psychropotidæ, but the individuals which have been at my disposal were in such a lacerated condition as to render it impossible to state anything concerning them. Likewise, on account of the number of its tentacles, I believe the genus *Achlyonice* to be justified. *Achlyonice paradoxa* being the typical form, seems, by its constant twelve tentacles, by the form of its body, and by other distinctions, to be easily distinguished from other genera, while the other species, *Achlyonice lactea*, having either eleven or twelve tentacles, approaches more to the genus *Elpidia*. Besides, the genus in question may easily be discerned by its calcareous bodies. In addition, I have tried to find out suitable generic characters from the shape of the body, as well as from the forms of the dorsal appendages, and, above all, from the construction of the calcareous deposits. *Parelpidia* differs from all other genera by its unusual length; it bears some similitude to the Synaptæ in its narrow cylindrical shape, with the mouth and anus at the opposite ends of the body, this resemblance being the more striking, as the dorsal surface is almost naked, its few processes being very rudimentary. Consequently, this genus is represented by forms which differ in their external shape most remarkably from the other Elpidiidæ. Notwithstanding this, a conformity not to be neglected really exists between them, in the arrangement of the internal organs, as well as in the position of the pedicels and the form of the calcareous deposits. It is worthy, indeed, of observation that the four-armed deposits of *Parelpidia* always carry but one process, while the other genera, *Elpidia*, *Peniagone*, and *Scotoanassa*, provided with similar calcareous bodies, always seem to bear, besides those deposits with one process, numerous others having two to five processes. It is possible that after the discovery of some new forms this difference may turn out to be of little or no importance, but, in the present state of our knowledge, it deserves to be kept in mind. The genus *Scotoanassa* seems to represent the type of a new genus on account of its singularly depressed body, and the flattened margins surrounding the anterior and posterior extremities.

On the other hand, it might seem that too little attention is given to the shape of the body by including animals of very different appearances in the genus *Elpidia*. The difference between such forms as *Elpidia glacialis* and *Elpidia verrucosa* on the one side, and *Elpidia willemoësi* on the other, is most conspicuous, this latter species being distinguished partly by the flatness of the posterior end of the body, and partly by the pedicels round this posterior end being webbed together by an extension of the integument. If this peculiarity should call for a new genus, *Peniagone vitrea* and *Peniagone affinis*, for instance, though closely related, for the same reason ought to be separated from one another, the consequence of which would be, in our opinion, that generic division was being urged too far; possibly a separation into sub-genera might, on account of what is mentioned, be justified. I have felt somewhat doubtful whether *Elpidia glacialis*, might not keep its place as the sole representative of the original genus, thus necessitating a new genus for the remaining species, and I am of opinion that this separation might be fully justified—particularly as the calcareous deposits and the construction of the calcareous ring give plain evidence—if I were quite persuaded that *Elpidia glacialis* really is the only form in which the madreporic canal does not communicate with the exterior. Failing this I feel obliged to leave the definite decision of this point to further investigations. The dorsal appendages are found to be of two different kinds, one having the form of larger or smaller, more or less elongated conical processes, enclosing a single canal, the other, on the contrary, consisting of a generally very prominent and broad lobe traversed by several canals. *Parelpidia*, *Elpidia*, *Scotoplanes*, *Kolga*, *Irpa*, and *Achlyonice* carry appendages of the former kind, while the three other genera of this family bear a dorsal lobe of greater or smaller dimensions. The conical processes are usually situated on the anterior part of the dorsal surface, though one pair or more are also to be found posteriorly, as, for instance, is the case in *Scotoplanes globosa*, *Scotoplanes murrayi*, and *Elpidia glacialis*; especially in the latter species they vary in number as well as in position. The dorsal lobe seems to arise exclusively from the anterior part of the back, as in the genus *Peniagone*, or constitutes a rather broad brim round the anterior flat extremity of the body, as is the case in *Scotoanassa* and *Enypniastes*. It might seem as if these two forms of dorsal appendages should offer particularly valuable generic characters by representing the animals in very different aspects, but it must be noted that a series of gradations is to be found between the lobes and the conical processes. I am of opinion that *Kolga hyalina*, &c., is a striking example, in having its processes disposed in a transverse row, and united at their base, thus running out from a low ridge.

The calcareous deposits of the integument represent several types, also suitable for drawing lines of demarcation between the genera. The four-armed deposits, being the most common, are found in *Parelpidia*, *Elpidia*, *Scotoanassa*, and *Peniagone*,—excepting *Peniagone naresi*,—and resemble one another so closely, that no important peculiarities are to be found among them. Besides, these deposits which sometimes, as for instance in *Elpidia glacialis* and *Elpidia ambigua*, are associated with small wheel-shaped bodies, seem to be of little or no value in defining species. With regard to the four-armed deposits of *Elpidia glacialis* they certainly differ very considerably from all others of the same kind, though constructed after the same idea. The three-armed bodies are found in *Achlyonice*, *Scotoplanes insignis*, *Scotoplanes robusta*, and *Peniagone naresi*,—the latter possessing besides those C-curved spicula, otherwise exclusively characteristic of the genus *Scotoplanes*. I do not attach so much importance to the three-armed shape of the deposits as to feel justified in associating the above-mentioned forms with one another. *Kolga* and *Irpa* are very closely allied to one another, and have very small horseshoe-shaped spicula, which are peculiar to them. I do not think it possible to found the determination of genera on the form of the calcareous bodies alone, and I consider the value of the characters which they present to be of necessity subordinate to those depending upon the number of the tentacles, the form of the body, and the conformation of the dorsal appendages; it is of comparatively slight importance if a species is seen to agree as to its deposits more closely with another genus than with the other species of its own genus.

The madreporic canal offers distinctions which seem to be most applicable as generic characters. It is either connected to the inside of the body-wall, as in *Irpa* and *Elpidia glacialis*, or it pierces it, thus communicating with the exterior, as is the case with *Kolga hyalina* and several other species. From want of materials, however, I have not been able to examine the madreporic canal in all the different species, wherefore I am obliged to neglect taking it into account in the classification. I know with certainty no other forms than *Irpa* and *Elpidia glacialis* in which the madreporic canal is connected to the body-wall and does not communicate with the exterior. It is, however, remarkable that these two modes of termination of the madreporic canal, though of the greatest importance, do not induce any perceivable changes in the conformation or appearance of the body, as is easily seen by comparing with one another *Elpidia glacialis* and *Scotoplanes globosa*. Even if I had been able to study the madreporic canal in all the forms of this family, I should certainly have hesitated to choose as generic characters anatomical peculiarities which in most cases can be distinguished only with the greatest difficulty and by means of particular microscopical research, excepting, of course, where these peculiarities are accompanied by others.

The variability in the position of the pedicels, which are sometimes arranged all along each side of the body, sometimes wanting in the anterior half or third of the ventral surface, and sometimes present only round the posterior extremity of the body, does not give suitable generic characters. I have only once made use of this peculiarity of the pedicels, when establishing the genus *Scotoanassa*, which is most peculiar on account of its pedicels running out from the margin of the considerable brim which surrounds the posterior extremity of the body.

Thus, as stated above, there are great difficulties at present in producing a natural classification of the family Elpidiidæ.

Tabular View of the Genera of the Family ELPIDIIDÆ.

I. Tentacles ten.	
A. Dorsal surface with processes most frequently of considerable size.	
a. Body very long, cylindrical, Synapta-shaped. Processes of the dorsal surface almost inconspicuous. Calcareous deposits four-armed, with a single long central process, directed outwards,	Gen. I. *Parelpidia*, n. gen.
b. Body more or less elongated ovate, cylindrical, or depressed posteriorly. Processes of the dorsal surface generally large.	
1. Calcareous deposits : four-armed bodies with large processes, and, besides, sometimes small wheels,	Gen. II. *Elpidia*, Théel.
2. Calcareous deposits : unbranched spicula or three-armed bodies; and, besides, always small C-shaped spicula,	Gen. III. *Scotoplanes*, n. gen.
3. Calcareous deposits : simple, irregularly curved, horse-shoe-shaped bodies, scattered straighter spicula, and sometimes a few perforated, net-like plates—	
×. Madreporic canal opening externally,	Gen. IV. *Kolga*, Dan. & Kor.
× ×. Madreporic canal not opening externally,	Gen. V. *Irpa*, Dan. & Kor.
B. Dorsal surface with a large lobe-like appendage anteriorly, and commonly with some minute processes,	Gen. VI. *Peniagone*, n. gen.
C. Body very depressed, almost flat, with a large brim round its anterior and posterior ends,	Gen. VII. *Scotoanassa*, n. gen.
II. Tentacles eleven to twelve,	Gen. VIII. *Achlyonice*, n. gen.
III. Tentacles twenty,	Gen. IX. *Enypniastes*, n. gen.

Parelpidia, n. gen.

Body very elongated, cylindrical, Synapta-like, five or six times longer than broad. Tentacles ten. The dorsal surface in its anterior part only provided with a few rudimentary, almost inconspicuous processes. The ventral surface without pedicels in its anterior part. Integument with calcareous deposits, composed of four arcuate arms directed towards the inside of the body, and one central, long and straight process directed outwards.

Parelpidia elongata, Théel (Pl. I. figs. 3, 4).

Elpidia elongata, Théel, Preliminary Report on the Holothuridæ of H.M.S. Challenger, p. 17.

Mouth anterior, subterminal. Anus posterior, dorsal. Tentacles of almost equal size; their terminal part rather large, with numerous small retractile processes, and with an incision in the outer edge. Pedicels, eight along each side of the ventral surface, and behind the anus an azygous one, flat and twice as broad as the others, having the point obtuse and incised in its middle; the two or three posterior pairs flat, broader and longer than the others. The dorsal surface with about three pairs of very small, rudimentary processes on its anterior part.

Colour in alcohol, light grey. Length, about 150 mm. Breadth, about 25 mm.

Habitat.—Station 299. December 14, 1875. Lat. 33° 31′ S., long. 74° 43′ W. Depth, 2160 fathoms; bottom temperature, 1·1° C.; grey mud. One incomplete specimen.

The body is of almost equal breadth throughout, the posterior end being suddenly rounded. The mouth, the rather large oral disk, and the tentacles are slightly bent towards the ventral surface. The anus is large, perfectly dorsal, and placed near the posterior end of the body. The anterior part of the body is destitute of pedicels, the first pair being situated almost at the middle of the body or somewhat anteriorly. The pedicels, eight along each side, are disposed in pairs; the odd pedicel is situated behind the anus at the posterior end of the body. Three different kinds of pedicels are to be distinguished. The first five or six pairs, 8 or 10 mm. long, are almost cylindrical, with the end a little enlarged. The two or three posterior pairs are considerably longer, almost 13 or 14 mm., flattened, broadest at the middle, and tapering towards the end. The odd pedicel is also flat, and twice as broad as the others; it is not longer than about 7 mm., and its breadth is a little greater than its length. The free obtuse end of this pedicel is distinctly emarginated, and its upper and lower surfaces are concave in the middle. The processes of the dorsal surface are very small, visible only as spots on the anterior part of the back; they are six in number and irregularly disposed, three along each ambulacrum. The perisoma is rather thick, with five longitudinal lines marking out the five muscular bands. Exteriorly, the integument is provided with very small papillæ, each of them containing a four-armed calcareous deposit (Pl. XXXII. fig. 16), the form of which has been already described in the character of the genus. The four curved arms of that deposit are directed towards the base of each papilla, and the long central process towards the top. The arms as well as the process are more or less spinose, though it is impossible to decide to what degree, several calcareous bodies having been thoroughly dissolved and the rest considerably deformed, the alcohol, in which this animal as well as some others had been preserved, probably having become acid. The length of the arms of those calcareous bodies is about 0·12 mm. The end of the pedicels contains a number of larger and smaller unbranched spicula and four-armed irregular bodies (Pl. XXXII. fig. 17).

As usual in this family the calcareous ring (Pl. XXXVII. fig. 2) is composed of five radial pieces or spicula, as I prefer to call them, which, being separated from one another in this species, do not form a complete ring round the gullet. Each spiculum consists of a short central part, from which radiate on each side ten to fourteen slender rods, 0·8 mm. long, slightly arcuated, and towards the end widened, flattened, and more or less branched. In the layer of connective tissue round the calcareous ring is a quantity of more or less irregular four-armed bodies, resembling those of the pedicels. Two ventral polian vesicles are to be observed, one on each side, and two other rudimentary prolongations are given off from the circular vessel. The madreporic canal seems to be destitute of calcareous deposits, and it has not been possible to determine whether it pierces the wall of the body or not. The reproductive organ, only 25 or 30 mm. long, is composed of two branches, each enlarged posteriorly and divided into a number of small bundles of cæcal branches. The anterior part of the organ also carries at its sides some small, thin bundles of the same shape. On the nerve ring are to be observed small auditory vesicles containing thirty or forty otoliths of the usual ovate form, with one end abruptly broken off, and with three to four concentric layers; the size of these otoliths varies from 0·21 to 0·04 mm. in length.

Parelpidia cylindrica, n. sp. (Pl. I. figs. 1, 2).

Mouth anterior, terminal. Anus posterior, dorsal. Tentacles bearing on their terminal part small retractile processes. Pedicels nine along each side of the ventral surface, of almost equal size, the posterior pairs being a little longer but thinner. The dorsal surface with two pairs of very small rudimentary processes on its anterior part.

Colour in alcohol, light grey. Length, about 185 or 190 mm. Breadth, about 36 or 70 mm.

Habitat.—Station 298. November 17, 1875. Lat. 34° 7′ S., long. 73° 56′ W. Depth, 2225 fathoms; bottom temperature, 1·3° C.; grey mud. One incomplete specimen.

The body is of an almost cylindrical form, but tapers slightly towards each extremity, the thickness being not quite the same throughout. The mouth and tentacles are almost terminal. The anus is large, dorsal, and situated near the posterior end of the body. The tentacles are doubtless ten in number, though in the only specimen existing in the collection only five are left; the rest have apparently been torn off. As their terminal part is more or less contracted, it is impossible to state correctly the form or number of the processes. Like the preceding species, this one is destitute of pedicels on the anterior part of the body, the first pair arising about 70 or 75 mm. behind the tentacles. The first five pairs of pedicels have a cylindrical form with the ends slightly enlarged; the posterior parts are narrower and a little longer. As in *Parelpidia elongata*, the spaces between the different pairs decrease backwards, so that the four hindmost pairs are close together at the posterior extremity of the body. The dorsal surface is furnished with four very small rudimentary processes, arranged in pairs, two on each ambulacrum, the first pair being situated 20 mm. and the posterior pairs about 45 mm. behind the tentacles. The perisoma is quite transparent and very thin, so that the five broad yellowish muscular bands are distinctly visible through it; its surface is scattered over externally with very small papillæ, each containing a calcareous deposit, evidently of almost the same shape as in *Parelpidia elongata*. Unfortunately, those deposits are quite dissolved, and it is only by treating the skin with hæmatoxylin or carmine that their outlines can be distinguished.

The alimentary canal is narrow; it descends to the anal extremity of the body, where it turns upon itself and forms a small circumvolution. Throughout the whole of its course, the alimentary canal is attached to the wall of the body by larger or smaller bands. The cloaca is of inconsiderable dimensions. The polian vesicles, ventral and two in number, are 12 mm. long. The madreporic canal is rather thick and, after penetrating the perisoma, communicates with the exterior by a pore situated not very far behind the tentacles. I have not been able to observe more than a single pore, although possibly there might be several. The reproductive organ is unusually long, nearly the length of the body, consisting of two very slender tubes of almost equal thickness throughout and divided posteriorly into thread-like branches. The tubes carry here and there thin bundles of such branches, and anteriorly, where both of them join and form a wide sack-like extension, there are several other small, very close-set bundles of slightly thicker branches. The whole reproductive organ is therefore very slender, almost filiform. The two species of this genus are evidently nearly allied. The transparency of the integument and its extreme thinness, the length and slenderness of the reproductive organ, the number of the processes, and especially the shape of the pedicels, distinguish this species from the preceding one.

Elpidia, Théel.

Elpidia, Mem. sur l'Elpidia, nouv. genre d'Holothuries; Kongl. Sv. Vet. Akad. Handlingar, Bd. 24, No. 8, 1877.

Body oval, or more or less oblong, about twice or thrice as long as broad; sometimes depressed posteriorly. Tentacles ten. The dorsal surfaces with processes commonly few in number and mostly disposed only on its anterior part. Integument with calcareous deposits composed of four more or less curved arms issuing from a common central point, or from the ends of a more or less elongated central part, or from the sides of a long slender spiculum, and provided with one to five processes directed outwards; besides these bodies there are often small wheels.

Elpidia glacialis, Théel.

Elpidia glacialis, Théel, Note sur l'Elpidia; Bihang till K. Svenska Vet. Akad. Handlingar, Band 4, No. 4, Stockholm, 1876.
„ „ Théel, Memoire sur l'Elpidia; Kongl. Svenska Vetenskaps-Akademiens Handlingar, Band 14, No. 8, Stockholm, 1877.
„ „ Danielssen and Koren, Echinodermer fra den Norske Nordhavsexpeditionen; Nyt Mag. for Naturvidensk. xxiv. 3, Christiania, 1877.
„ „ Danielssen and Koren, Echinodermer fra den Norske Nordhavsexpeditionen, Nyt Mag. for Naturvidensk. xxv. 2, Christiania, 1879.

Body oval, about thrice as long as broad. Mouth anterior, subventral. Anus posterior, slightly dorsal. Tentacles of almost equal size; their terminal part bearing two larger and some smaller retractile processes. Pedicels large, four along each side of the ventral surface. The dorsal surface with rather long processes on each ambulacrum; they vary in number, and are more or less distinctly disposed in pairs. Integument transparent, brittle, and rough, with two sorts of calcareous deposits numerous: slender spicula of different lengths, bearing near their middle and at some distance from each other two pairs of arms, one on each side, and two short conical processes directed outwards; and very small, hat-shaped, scattered wheels.

Colour glassy. Length, about 22 mm. Breadth, about 8 mm.

Habitat.—Station 160. March 13, 1874. Lat. 42° 42′ S., long. 134° 10′ E. Depth, 2600 fathoms; bottom temperature, 0·2° C.; red clay. Only one specimen was brought home by the Challenger Expedition. Besides this, a great many individuals were taken in the Sea of Kara at a depth of 50 to 150 fathoms by the Swedish Arctic Expeditions, 1875 and 1876, and likewise a not insignificant number in the North Atlantic ocean by the Norwegian North Atlantic Expedition.

As has been mentioned, only one individual of this species was brought home by the Challenger Expedition. The discovery of this specimen in a locality so far south as the neighbourhood of the Antarctic sea is of the greatest interest, considering that this species during the last six or seven years has been found living rather commonly in the North Atlantic Ocean and in the Arctic Ocean (Sea of Kara). *Elpidia glacialis* seems able to exist under very various conditions; the individual brought home by the Challenger Expedition proves that it lives at the greatest depth, up to 2600 fathoms, while those from the Arctic sea are found at depths of only 50 to 150 fathoms. The southern form differs in various points from the northern one, but the difference is of very little importance. The dorsal surface bears only three pairs of processes, the first on the anterior part, the second in the middle and the third on the posterior part of the body. The number and position of these dorsal processes seem to be highly variable. Some of the tentacles do not quite agree with the figure given by me in the above cited memoir on *Elpidia glacialis*, but that dissimilarity is accounted for by the fact that only the two larger processes were extended in the first individuals I saw, the other ones being retracted. The small hat- or wheel-shaped deposits scattered in the integument of the northern form have not been detected, but, from the fact that the comparatively very large spicula are rather deformed, I suppose that these very minute deposits have already been dissolved. It seems that the size of the animal considerably surpasses that stated above, and this is especially the case with the individuals brought home by the Norwegian North Atlantic Expeditions. *Elpidia glacialis* is easily distinguished from all other known forms of the same family by the peculiar shape of its calcareous deposits, and from the other species of the genus *Elpidia* by its singular calcareous ring, of which I have given a detailed account in my above-mentioned memoir. As to the ambulacral system and the wrong opinion expressed by myself and Drs Danielssen and Koren, I refer to the anatomical part of this report.

Elpidia verrucosa, Théel (Pl. III. figs. 1, 2).

Elpidia verrucosa, Théel, Prelim. Report on the Holothuridæ, p. 15.

Body sub-ovate, nearly twice as long as broad. Mouth anterior, terminal. Anus posterior, slightly dorsal. Tentacles of apparently equal size, their terminal part bearing small retractile processes. Pedicels rather large, nine along each side of the ventral surface. The anterior part of the ventral surface destitute of pedicels. The dorsal surface with two pairs of processes in its anterior part. Integument extremely brittle and hard, with numerous, rather large, pyramidal papillæ, crowded especially on the back, each papilla containing a calcareous deposit, composed of four long, spinose, arcuate arms, directed towards the inside of the body, and one or two central large and straight processes, directed outwards from the body.

Colour in alcohol, light violet with some darker spots. Length, about 52 mm. Breadth, about 28 mm.

Habitat.—Station 299. December 14, 1875. Lat. 33° 31′ S., long. 74° 43′ W. Depth, 2160 fathoms; bottom temperature, 1·1° C.; grey mud. One specimen.

This species, of which only a single individual is preserved in the collection, has the body ovate, short, and about twice as long as broad. The mouth is terminal, slightly turned towards the ventral surface. The anus is large, of an almost triangular form. Only five tentacles are left, but traces are seen of five others which have been torn off; some of those of the ventral surface seem to be a little smaller. The tentacles are very hard, brittle, and non-retractile; their ends are rather large, bearing round the edge small retractile processes, the form and length of which are unknown. In consequence of their brittleness several pedicels are broken, but from the traces left on the body-wall they seem to be eighteen in number, nine along each side of the ventral surface. As the first pair is situated almost 20 mm. behind the tentacles, the anterior part of the body is destitute of pedicels. This first pair is comparatively the largest, about 9 or 10 mm. in length, and the others diminish gradually backwards, the hindmost ones being very small. The ends of the pedicels are slightly enlarged. As the processes on the dorsal surface are torn off, it is impossible to state their length and appearance, but the large holes in the body-wall indicate clearly that they must have been of great size and four in number. They project from the anterior part of the back and are arranged in pairs of which the first one is a little closer to the middle line of the back than the others. The integument, especially on the back, is of an unusual solidity and brittleness, in consequence of the presence of numerous crowded pyramidal papillæ (Pl. XXXIX. fig. 2), which are larger and visible to the naked eye on the back, but towards the ventral surface are almost indistinguishable. Each papilla contains a calcareous deposit (Pl. XXXIV. fig. 3) composed of four, up to 0·6 mm. long, spinose, arcuate arms, following the four edges of the papilla towards its base, and one or two rather long, straight, spinose processes directed outwards from the body; these processes run out from the centre of the deposit, that is to say, almost from the top of the papilla, where the arms are joined together. The integument is therefore rather rough. As the papillæ are largest and most distinct on the back, so the calcareous deposits also are largest there, their arms being more distinctly curved and directed inwards than is the case with those of the ventral surface. The pedicels as well as the tentacles are furnished with a great number of deposits, resembling those of the ventral surface of the body, but commonly a little smaller and with the arms more irregularly curved. Besides, several other kinds of deposits (Pl. XXXIV. fig. 4) are to be found, especially in the pedicels, viz., four-armed ones with the arms either unusually long and curved or short and straight; and smaller or larger, unbranched, straight or curved, more or less spinose spicula.

The polian vesicle is 4 mm. long. The alimentary canal is of a brownish colour. The cloaca is large and without any cæcal prolongation.

Elpidia rigida, n. sp.

Body subovate, nearly twice as long as broad. Mouth anterior, ventral. Anus posterior, subdorsal. Tentacles of apparently equal size, their terminal part bearing numerous small retractile processes. Pedicels rather large, ten (?), all along each side of the ventral surface. The dorsal surface with about five (?) short, obtuse, thick processes round its anterior part. Integument thin, brittle, and very rough, with a great number of larger and smaller calcareous deposits, composed of four spinose slightly curved arms of variable length, and five long, straight, spinose processes directed outwards, one running out from the centre of the deposit and the others from the arms.

Colour in alcohol, light grey. Length, about 32 mm. Breadth, about 16 mm.

Habitat.—Station 241. June 23, 1875. Lat. 35° 41′ N., long. 157° 42′ E. Depth, 2300 fathoms; bottom temperature, 1·1° C; red clay. One very incomplete individual.

The only specimen I have had at my disposal is so incomplete and contracted as to make it impossible to form a correct idea of the shape and general appearance. The body seems, however, to be more or less ovate, and projects a little further than the mouth, which is thus rendered thoroughly ventral in position. The tentacles seem to be nearly of equal size, and their circular, rather large, terminal part is provided with numerous small retractile processes. It is rather difficult quite correctly to state the number of pedicels, but I believe them to be twenty in all, ten along each side of the ventral surface. They are rather large and brittle, so that they are easily broken off when touched. The integument is thin and very brittle, in consequence of a great number of calcareous deposits being closely crowded one upon another. Those calcareous deposits (Pl. XXXII. fig. 18) have an almost cross-like form, with the arms slightly curved, more or less spinose and very long, sometimes up to 0·48 mm. From the centre of the deposit there rises a long, more or less straight, spinose process, and a similar one proceeds from each arm, at some distance from the centre. As those processes are directed outwards from the body, the integument becomes very rough. The deposits of the pedicels and tentacles (Pl. XXXII. figs. 19, 20) are either of the same shape as those in the integument of the body or consist of unbranched, more or less spinose spicula, or they are, lastly, composed of irregular four-armed bodies, with the arms short, thick, spinose, and with or without any processes.

The polian vesicle is rounded and 5 mm. long. The madreporic canal seems to be destitute of calcareous deposits in its walls; however, I have not been able to ascertain whether it pierces the body-wall or is only attached to its anterior surface; I thought I observed the former to be the case.

Elpidia purpurea, n. sp. (Pl. VII. figs. 4–6).

Body nearly oval, or of almost equal breadth throughout, more or less depressed, little more than twice as long as broad. Mouth anterior, ventral. Anus posterior, terminal, subdorsal. Tentacles of almost equal size; their ends with small, retractile processes, those round the edge being larger than the others. Pedicels, fifteen or eighteen in number, only round the posterior half of the ventral surface. The foremost part of the dorsal surface with two pairs of rather long slender processes directed forwards, one a little behind the other. Integument thin, transparent, rather rough, with numerous crowded calcareous deposits, composed of four long, spinose, more or less arcuated arms, each bearing a long, spinose process.

Colour in alcohol, violet. Length, about 37 mm. Breadth, about 16 mm.

Habitat.—Station 147. December 30, 1873. Lat. 46° 16′ S., long. 48° 27′ E. Depth, 1600 fms.; bottom temperature, 0·8° C.; globigerina ooze. One specimen. Also a single individual was dredged at Station 157. March 3, 1874. Lat. 53° 55′ S., long. 108° 35′ E. Depth, 1950 fathoms; diatom ooze.

I intend first to describe a little more in detail the individual from Station 147, and then to point out by what this differs from the one dredged at Station 157. The body is elongated, almost oval, with the posterior end evenly rounded; the anterior, on the contrary, is suddenly truncated. The back is but slightly convex, and the ventral surface almost flat, the body thus looking rather depressed. The mouth is completely ventral and situated a little behind the foremost truncated part of the body. That part which projects in front of the mouth consists of a brim or border-like enlargement of the body-wall, which gives to the foremost end of the body the appearance of being very thin and flattened. This brim carries at its front on each side a pliable non-retractile process, 10 or 11 mm. in length, and a little behind each of those, another one of about the same length or a little shorter. The processes as well as the brim are directed forwards but can probably, at the will of the animal, be bent upwards; they belong to the dorsal ambulacra. The tentacles (Pl. XLIV. fig. 6) are of almost equal size, and their terminal part is provided round the edge with a number of small retractile processes of which two seem to be a little larger than the others; besides, the terminal part carries a great number of papilla-like retractile projections of a dark violet colour. We have not succeeded in observing any tentacle completely extended. Pedicels are wanting on the anterior half of the body; round its posterior half, however, they are arranged to the number of fifteen or sixteen. The calcareous deposits of the integument (Pl. XXXIII. figs. 13, 14), which are numerous and very crowded, are composed of a more or less elongated central part, from each of the ends of which run out two long, spinose, more or less arcuate, arms, with the ends somewhat widened; near its attachment each arm bears a long spinose process. Even the pedicels, tentacles, and dorsal processes are provided with a great number of deposits of the same shape, both the first ones having, besides, at their ends some curved, slightly spinose spicula, and some four-armed bodies without processes, and with the arm considerably spinose and arcuate. The colour of individuals preserved in alcohol is violet, with the back a little darker; the terminal parts of the tentacles are almost black violet.

The calcareous ring does not seem to be continuous, but consists of five pieces separated one from another, each being composed of a number of rods radiating in two directions from a common centre. The reproductive organs consist of two wide, short tubes bearing small bundles of cæca; they open into a single common duct having its orifice immediately in front of the tentacles in the downwardly directed part of the dorsal surface. Both of the tubes of the organ contain numerous calcareous deposits in the form of spicula. I have not been able to examine the madreporic canal. The alimentary canal is of a violet colour.

The individual obtained from Station 157 shows several peculiarities which I shall now point out. The size itself is considerable in comparison with that of the above-described specimens, the length amounting to 55 or 60 mm. and the breadth to about 25 mm. The body is of almost equal breadth throughout, with its posterior end abruptly rounded, thus differing very considerably from the oval form peculiar to the preceding. The dorsal surface also projects considerably in front of the mouth, which thus becomes thoroughly ventral, and is situated about 10 or 12 mm. behind the transversely truncated anterior end of the body. The processes which constitute the first pairs are 22 mm. long, and the posterior ones a little shorter. The pedicels are eighteen in all, nine arranged along each side of the posterior half of the ventral surface. On comparing the individuals from Station 146 it becomes evident that the anterior half of the body is always wanting in pedicels, while the number of the pedicels on the posterior half may vary a little. The calcareous deposits within the integument are very crowded and rather small, their arms attaining only to about 0·1 mm. in length; for the rest, the size varies a little in the same animal, the deposits being considerably larger in some parts of the body than in others. This variation in size is also accompanied by a rather considerable alteration in the appearance of the calcareous deposits. I have here been able to examine the calcareous ring more closely than in the above described individual; each of its five pieces or spicula, separated one from another, consists of a short central part, which gives off, in opposite directions, about eight long rods, the ends of which seem to be a little flattened, broad, and as if they were dichotomously branched. Supposing the ends of the rods to be united one with another by a line, it seems that such a line should then describe a semi-circle. The madreporic canal pierces the body-wall and thus brings the ambulacral system into connection with the surrounding medium; its pore is situated nearer the tentacles than I have observed in any other form described here. The madreporic canal seems to be destitute of calcareous deposits in its wall, which is most singular, as the reproductive organ, except the narrow efferent duct, is provided with numerous, crowded, rather straight, and slightly spinose spicula. The reproductive organ ought properly to be considered as a single fascicle composed of two bundles; its long common efferent duct bears several small bundles. This duct has the peculiarity of being divided, a little before reaching the body-wall, into two diverging canals, which open far apart from one another, one on each side of the pore of the madreporic canal.

Elpidia willemoësi, n. sp. (Pl. VIII. figs. 2, 3).

Body elongated, of almost equal breadth throughout, about twice and a half as long as broad, considerably depressed backwards, and the posterior very flat extremity with an incision in its middle. Mouth anterior, ventral. Anus posterior, dorsal. Tentacles large, of almost equal size, some of the ventral ones a little smaller than the others; their terminal part with retractile processes. The dorsal surface with three large, rather short, lobe-like processes, arranged in a transverse row at its foremost part, the middle one larger than the others, and with one or two very small, rudimentary processes on each ambulacrum a little behind the former ones. Pedicels ten, all along each side of the ventral surface, rather large, the hindmost pairs a little smaller. Integument thin, transparent, with two sorts of calcareous deposits numerous: large four-armed bodies, each arm slightly curved, and with numerous long spines and spinose processes; smaller ones with the arms less spinose, but more arcuated, and with two to four rather long, spinose processes, directed outwards, or with only one central process.

Colour in alcohol, light grey. Length, about 85 to 90 mm. Breadth, about 35 mm.

Habitat.—Station 156. February 26, 1874. Lat. 62° 25′ S., long. 95° 44′ E. Depth, 1975 fathoms; diatom ooze. One almost complete and three incomplete specimens.

The body is more or less distinctly elongated and the anterior part, in individuals preserved in alcohol, is considerably narrower than the posterior. The ventral surface is almost flat, and the back slightly convex, the height of the body being thus not very considerable; the greatest height is at its middle and anterior part. Posteriorly, the dorsal surface gradually approaches the ventral surface, so that the posterior obtusely rounded, almost truncated, extremity of the body is rather flattened; it is incised in its middle, so that it gives the impression of being bilobed. The anterior part of the body terminates in three short, obtusely triangular processes or lobes, disposed in a transverse row, and having their bases close to each other; the middle process is at its base several times broader than the other two. The body-wall surrounding those processes is thickened and projects from the mouth, which thus acquires a thoroughly ventral position. In the single uninjured specimen we have had at our disposal, not only the tentacles, but also a neck-like portion of the body, supporting them, protrudes below the ventral surface, forming thus a distinct angle with it. In a thoroughly extended state it seems probable that the animal might change, in some degree, the position of this neck-part, so as to stretch it forwards, possibly beyond the three dorsal processes, which, instead of being directed forwards, ought to be turned more upwards. The anus is situated on the dorsal surface immediately in front of the incision in the posterior extremity of the body. The tentacles are of rather inconsiderable size, some ventral ones being a little smaller than the others. Their terminal parts are, as usual, mostly retracted, and bear a number of retractile processes, which, especially towards their extremities, are provided with very small brownish projections, resembling those I have represented in *Orphnurgus asper*. The pedicels are ten all along each side of the ventral surface, the posterior pairs being somewhat smaller than the others, which are of rather a remarkable size. The first five or six pedicels on either side are distinctly separated from one another by certain distances, while the other ones are close-set side by side; the former are directed downwards and slightly backwards, while the latter or posterior ones are directed outwards and backwards, proceeding from the margin of the very thin posterior end of the body. The wide canals of these posterior pedicels are continued directly inwards and traverse without discernible diminution the brim-like thickened perisoma, which surrounds the hind-part of the body; hence one cannot help thinking that these pedicels are also in reality long, but have their ends alone free, being for the rest of their length webbed together by an extension of the integument. From these close lying canals being visible through the skin, the posterior extremity of the body has almost a fin-like appearance. In addition to the three above-mentioned lobe-like appendages, there are on the dorsal surface some minute processes, one placed on the right ambulacrum and two on the left. The integument is whitish, rather thin and transparent. The larger calcareous deposits (Pl. XXXIII. fig. 10) have their four arms about 0·2 mm. long, almost straight or slightly curved with a number of large spines, each arm sending out one or several spinose processes; they have no central processes, lie in the internal layer of the connective tissue of the body-wall, and are to be found in greatest number on the sides of the body. The other calcareous deposits are far more numerous. Their four arms are only half as long but more curved and covered with considerably smaller spines; the arms either meet in a central point or are united by a shorter or longer rod-like central part. These deposits have either a single slightly spinose, straight process proceeding from the centre, or two to four similar ones, situated more or less distant from the centre; those with two to four processes predominate on the ventral surface, while those with only one process are to be found on the back and in the pedicels, where the process attains a considerable length.

I have occasionally seen some C-shaped bodies, but their rarity has made me fear that they do not belong to the animal, but have happened to stick to the skin.

The oral disk contains, besides the four-armed deposits with four processes, unbranched spicula as well as three-, four-, and many-armed, irregular, finely spinose bodies. The ends of the tentacles and pedicels are provided with numerous larger or smaller, straight or slightly curved, spinose spicula (Pl. XXXIII. figs. 11, 12); besides, the ends of the pedicels contain some four-armed slightly spinose deposits.

Each of the five separated pieces of the calcareous ring (Pl. XXXVII. fig. 1) is composed of a small oblong central part, each end of which sends out a radiating bundle of ten to fifteen rods, which have their extremities more or less ramified and flattened. These five pieces constitute the radial parts of the ring, while every trace of inter-radial pieces between them is totally wanting. There are two polian vesicles, one on each side of the ventral surface; their length is rather inconsiderable, only 7 or 8 mm. The madreporic canal penetrates the body-wall and opens externally by a pore, situated a little in front of the genital aperture; its parietes contain only a few scattered spicula, but the body-wall round its aperture is provided with large close-set, four-armed, more or less irregular calcareous deposits. The cloaca is small and insignificant. The reproductive organ consists of two large, wide tubes, which communicate anteriorly with a narrow efferent duct which opens at the top of a very small papilla placed immediately above the downwardly directed neck-part of the body. The said tubes bear scattered thin bundles of rather large, elongated cæcal sacs.

Elpidia incerta, n. sp. (Pl. VIII. fig. 1).

Body elongated, about twice and a half as long as broad, considerably depressed posteriorly. Mouth anterior, ventral. Anus posterior, dorsal. Tentacles large, of almost equal size, some of the dorsal ones a little smaller; their terminal part very large, circular and discoidal, with numerous small retractile processes. The dorsal surface with a pair of indistinct, tuberous processes at its foremost part. Pedicels ten, all along each side of the ventral surface, rather large, the posterior pair a little smaller. Integument thin, slightly rough and transparent, containing calcareous deposits, composed of four arms and two to four processes, resembling those of the preceding species.

Colour in alcohol, white. Length, about 90 mm. Breadth, about 27 mm.

Habitat.—Station 152. February 11, 1874. Lat. 60° 52′ S., long. 80° 20′ E. Depth, 1260 fathoms; diatom ooze. Four incomplete specimens.

This species seems to be most closely allied to *Elpidia willemoësi*; the four individuals brought home by the Challenger expedition differ indeed so slightly from it, that I have long been in doubt whether it is justifiable to refer them to a new species or not. The body has its greatest height, about 20 mm., anteriorly and thence it diminishes gradually backwards, the hindmost extremity becoming thus very thin. Anteriorly, where the body attains its greatest height, the dorsal surface bends rather abruptly downwards, forming a kind of rounded hump, whereby the neck-like narrow portion of the body, which supports the mouth and the tentacles, seems to have an almost perpendicular direction; thus the mouth has a thoroughly ventral position. The tentacles—only six are left in one specimen, and they are altogether torn off from the other three individuals—do not seem to be of quite equal size, a couple of the dorsal ones being a little smaller. Their terminal part is uncommonly large, circular, flat, and discoidal. The pedicels resemble in size and position those of the preceding species, excepting that here the first pair is placed a little further from the tentacles. The back bears only two tuberous indistinct projections, lying side by side, and situated just on the above-mentioned hump; they are so contracted and indistinguishable that their existence can be ascertained only by opening the animal and looking for their ambulacral cavities. The integument is rather thin and transparent, so that the thick yellowish muscular bands are obvious through it. The calcareous deposits (Pl. XXXIII. fig. 3) are represented by a great number of close-set small four-armed bodies with a long rod-like central part; each arm, only about 0·064 mm. in length, is spinose, enlarged towards the end, a little curved, and provided with a shorter, extremely spinose, outwardly directed process; occasionally one or two arms are destitute of those processes. There is also another kind of deposit, with the four arms only slighly spinose, about 0·16 mm. long and bent towards one another, and with the two to three 0·14 mm. long processes straight and very little spinose. The terminal part of the pedicles bears a number of larger or smaller, more or less branched and curved spinose spicula (Pl. XXXIII. fig. 4). The terminal parts of the tentacles enclose an infinite number of larger or smaller, commonly extremely arcuated spinose spicula. The calcareous ring resembles that of *Elpidia willemoësi.* In the surrounding connective tissue there are numbers of simple and ramified, more or less curved, and towards the ends very spinose spicula, of about the same shape as those encountered in the muscular layer of the integument. The madreporic canal has a number of straight or curved, simple or three- or four-branched spinose spicula. The alimentary canal forms a great circumvolution, and is all along its length attached to the inside of the body-wall by means of numerous strong muscular bands and threads; there are no mesenteric membranes; its colour is white, excepting the cloaca and the part that lies nearest to the circular water-vessel, which are violet. The cloaca is rather considerable, but has no cæcal prolongation. The two polian vesicles are 20 or 25 mm. in length. The reproductive organ is composed of two, 20 or 25 mm. long, very thick dichotomously ramified bundles of small elongated cæcal sacs; the single efferent duct bears also some very small bundles. All along the two lateral ambulacra of the ventral surface, I have observed a great number, thirty to forty, of small auditory vesicles, containing numerous otoliths; some vesicles are situated more or less distant from the ambulacral nerves and communicate with them by a branch. The number and position of the dorsal processes, the size of the terminal parts of the tentacles, the fine ramification of the reproductive organ, and the want of the internally placed calcareous deposits of the integument, constitute the characters which distinguish this species from the preceding one.

Elpidia ambigua, n. sp.

Body elongated; about twice as long as broad, slightly depressed. Mouth anterior, ventral. Anus posterior, subdorsal. Tentacles of almost equal size; their terminal part large, discoidal, provided with small retractile processes. The dorsal surface with a pair of long slender processes at its foremost part, and immediately behind those, two or three very small ones. Pedicels only on the posterior half of the ventral surface, about seven along each side. Integument with two sorts of calcareous deposits; four armed bodies with four processes resembling those of *Elpidia purpurea;* and small wheels with eight or ten spokes.

Colour in alcohol, light violet. Length, about 35 mm. Breadth, about 15 mm.

Habitat.—Station 157. March 3, 1874. Lat. 53° 55′ S., long. 108° 35′ E. Depth, 1950 fathoms; diatom ooze. Two incomplete specimens.

The two individuals obtained from the above station are in such an incomplete state, that the description of them cannot be otherwise than very unsatisfactory. The form of the body it is almost impossible to state. All along each side of the body the perisoma forms a distinct list or brim, which may, however, depend on the contraction in alcohol. The terminal part of the tentacles bears a number of small retractile processes, of which two on its outer margin are largest; all these processes are, in their turn, provided with a number of very small retractile papilliform projections. Among the dorsal processes the first pair, situated on the anterior extremity of the body, is of considerable length, about 17 mm.; the pair placed immediately behind is very inconsiderable, and the processes arising close behind this second pair, one or two on each ambulacrum, are completely rudimentary, almost invisible. Pedicels are only to be observed round the posterior half of the ventral surface, and most of them being torn off it is impossible to state correctly their number; they seem to have been about fourteen, seven along each side, and of a rather considerable size. The calcareous deposits (Pl. XXXIII. fig. 6) in the integument are, as above remarked, of two sorts: four-armed bodies with four outwardly directed processes; and very scattered small wheels, 0·048 mm. in diameter, with eight to ten spokes, and with four curved minute rods, proceeding from the inner margin of the nave and united together in the centre. The four-armed deposits closely resemble those of *Elpidia purpurea;* their size, however, as well as the proportions between the arms and the processes is rather variable. The wheels are only to be found on the dorsal surface. The calcareous deposits being scattered, the surface of the skin does not feel very rough.

As may be seen, this species has a great resemblance to *Elpidia purpurea,* which, however, differs by its darker colour, by the greater number of calcareous deposits, and by its want of wheel-shaped bodies.

Tabular View of the Species of the Genus Elpidia.

I. Pedicels all along each side of the ventral surface.
  A. Body elongated, posteriorly depressed and flattened.
    a. Calcareous deposits: large four-armed bodies with numerous long spines and spinose processes; and smaller ones provided with two to four outwardly directed processes, . *Elpidia willemoësi.*
    b. Calcareous deposits: only small four-armed bodies with two to four outwardly directed processes, . . . *Elpidia incerta.*

B. Body ovate or oval.
  a. Calcareous deposits: four-armed, almost cruciform bodies, with five outwardly directed processes, ... *Elpidia rigida.*
  b. Calcareous deposits: four-armed bodies with the arms running out two from each opposite side of a long spicule, and provided with two outwardly directed processes; and small scattered hat-shaped wheels, ... *Elpidia glacialis.*
II. Pedicels only around the posterior half of the ventral surface.
  a. Calcareous deposits: four-armed bodies with one or two outwardly directed processes, ... *Elpidia verrucosa.*
  b. Calcareous deposits: four-armed bodies with four outwardly directed processes, ... *Elpidia purpurea.*
  c. Calcareous deposits: four-armed bodies with four outwardly directed processes; and small wheels with eight to ten spokes, ... *Elpidia ambigua.*

Scotoplanes,[1] n. gen.

Body varying from more or less elongated to ovate, almost globular, from once and a half to thrice as long as broad, sometimes depressed posteriorly. Tentacles ten. The dorsal surface with a small number of processes, often of remarkable length and size. The ventral surface with pedicels all along each side or only round its posterior half. Integument with two sorts of calcareous deposits: small spicula, curved in the form of a C; and either large, straight, unbranched spicula, or three-armed bodies.

Scotoplanes globosa, Théel (Pl. IV. and Pl. V. fig. 3).

Elpidia globosa, Théel, Preliminary Report on the Holothuridæ, p. 14.

Body ovate, more or less globular, from once and a half to twice as long as broad. Mouth anterior, terminal, slightly ventral. Anus posterior, subventral. Tentacles of equal size, their terminal parts bearing numerous, small, digitate, retractile processes. Pedicels seven along each side of the ventral surface, rather large. The dorsal surface, with three processes, disposed on each side of its ambulacra; the first pair in the anterior, and the second in the posterior part of the back, both of them very large elongated and conical; the third pair immediately behind the second, small and rudimentary. Integument very thin and transparent, with two sorts of calcareous deposits: small spicula, curved in the form of a C; and large straight spinose ones.

Colour in alcohol, light grey. Length, about 130 mm. Breadth, about 70 mm.

Habitat.—Station 157. March 3, 1874. Lat. 53° 55′ S., long. 108° 35′ E. Depth 1950 fathoms; diatom ooze. One specimen. Station 299. December 14, 1875. Lat. 33° 31′ S., long. 74° 43′ W. Depth, 2160 fathoms; bottom temperature, 1·1° C.; Grey mud. Twenty-five to thirty specimens.

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[1] Σκότος = darkness.

This specimen is distinguished by its obviously globular form, the dorsal surface being extremely convex, the ventral, on the contrary, almost flat. In size it surpasses all hitherto known forms of this family. The tentacles (Pl. XLIV. fig. 12) are wide, and their flat terminal part is large, about 9· mm. in diameter, discoidal and provided with a number of unbranched, digitiform, retractile processes, of which those round the edge, and especially two on the outside, are large. The pedicels are very large, of great circuit, and constantly consisting of seven pairs, of which the posterior ones are slightly smaller; the last pair, being generally very small, is not placed on the hindmost part of the ventral surface, but on the inside of and a little in front of the next pair, which consequently is the most posterior. The number of the processes and their arrangement seem always to be constant, but their size changes, though not greatly; in most cases they are of great size, equalling in length almost the breadth of the body; the hindmost pair is always rudimentary. The body-wall of the thinness of paper is soft and transparent, the radial nerve-cords, the ambulacral vessels and cavities being visible through it. The calcareous deposits consist of small spicula curved in the form of a C (Pl. XXXIV. fig. 8), which are more numerous than the comparatively larger spinose spicula (Pl. XXXIV. fig. 9), which, thinly scattered, are visible to the naked eye. Those first mentioned are frequently provided with an obvious enlargement in the middle, and taper towards both of their equally curved ends; the largest ones measure about 0·16 mm. in length, but most of them are considerably smaller; their form varies too, as to the degree of curvature. Those C-shaped deposits, which sometimes give off a third arcuated arm issuing from their middle, in which case the C-shaped form evidently vanishes, seem to be most numerous on the ventral surface. The straight spinose spicula vary in size, the largest measuring in length about 0·92 mm., or sometimes more; some individuals have those spicula more numerous than others, especially on the dorsal surface; they are not quite straight always, one or another being more or less arcuated.

The integument possesses besides those calcareous deposits, masses of small cell-like corpuscles containing a brown pigment. Calcareous deposits of almost the same form as those above described are found in the pedicels, tentacles, and processes, the C-curved ones in the pedicels being a little shorter and thicker; the large spicula are often apparently arcuated, sometimes even provided with one or several branches. The ends of the pedicels as well as those of the tentacles contain a number of larger or smaller, thicker, straight, more or less arcuated spicula, which are almost smooth, excepting their obtuse ends, which are rough and spinose; sometimes those spicula bear a larger branch. The transverse muscular layer of the body-wall and the five longitudinal muscular bands are very thin.

The five pieces of the calcareous ring are very small and far separated one from another; each piece consists of a short central part, from which run out towards each opposite side four thick and short diverging rods with rough outlines. The polian vesicle is single, measuring only 15 to 20 mm. in length. The thick cord-like madreporic canal pierces the body-wall, thus connecting the ambulacral system with the surrounding sea water; as usual, its aperture is situated in the medio-dorsal line, about 15 mm. behind the tentacles. The wall of the madreporic canal is particularly firm and thick, containing only a small number of calcareous deposits of the same C-curved shape as those in the integument of the body. In regard to the ambulacral system, I refer to the anatomical part of my report.

The alimentary canal is rather wide. It decreases at first slightly backwards, and dilates again gradually, so as to form a large, thick-walled cloaca, from the left side of which projects forwards a considerable cæcal prolongation. The alimentary canal is attached to the inside of the body-wall not by mesenteric membranes but by a number of longer or shorter elastic bands. The madreporic canal and the efferent duct of the reproductive organ are connected with each other as well as with the adjacent portion of the alimentary canal by a mesentery. The five vessels, which the water-vascular ring emits, are united with one another by a very thin transparent membrane, thus forming a cavity or sinus around the foremost part of the alimentary canal. The reproductive organ consists of a single fascicle made up of bundles of small oval cæca, and is situated on the left side of the medio-dorsal line. The organ opens immediately behind the pore of the madreporic canal. The walls of the alimentary canal, the blood-vessels, and the reproductive organ, as well as the elastic bands, which retain the alimentary canal in a proper position, contain C-curved calcareous deposits; sometimes I have observed in the respiratory organ some scattered, spinose spicula of about the same shape as those of the integument. The individual from Station 157 differs from the others by its gigantic size, 180 mm. by 110; besides, its dorsal processes seem to be comparatively smaller. The discovery of this characteristic species in two such far distant localities, as in the South Indian Ocean, not very far from the Antarctic Sea, and in the South Pacific Ocean, near Valparaiso, is in the highest degree interesting, and justifies the supposition that its distribution must be very extensive.

Scotoplanes mollis, Théel (Pl. II. figs. 1, 2).

Elpidia mollis, Théel, Preliminary Report on the Holothuridæ, p. 14.

Body ovate, about twice as long as broad. Mouth terminal, subventral. Anus posterior, terminal. Tentacles of almost equal size; their terminal part provided with two large retractile digitiform processes, and with several small ones. Pedicels six along each side of the ventral surface, rather large. Processes of the dorsal surface two, rather large, elongated and conical, flexible, placed side by side a little in front of the middle of the body, and two smaller ones issuing from each outer side of the former near their base. Integument very thin and soft, with small papillæ; calcareous deposits of two sorts: large, straight, spinose spicula, much scattered; and small ones more close set, in the form of a C.

Colour in alcohol, light grey, inclining to violet. Length, about 70 mm. Breadth, about 33 mm.

Habitat.—Station 160. March 13, 1874. Lat. 42° 42′ S., long 134° 10′ E. Depth, 2600 fathoms; bottom temperature, 0·2° C.; red clay. One specimen.

Only a single specimen having been obtained, it has been impossible to examine it more in detail. The terminal part of the tentacles is rather large, about 6 mm. in diameter, discoidal, and deeply incised in its outer margin, thus giving rise to two rather large processes; the whole terminal part, consequently also those two processes, are provided with a great number of very small, retractile, unbranched projections. At the first sight the processes of the dorsal surface (Pl. XLIV. fig. 2) seem only to be two, measuring in length about 20 mm., but by more careful examination, one finds that each of those consists of two, that is to say, that another process, considerably smaller, exists on the outer side of each of those first mentioned, and is united with them by a web, only the top being visible. The integument is very thin, soft, and transparent, and is covered all over with small papillæ, which are most numerous and conspicuous on the pedicels and the tentacles as well as at the top of the processes. In each papilla are to be found minute fibres, which are probably nerves. The calcareous deposits (Pl. XXXIII. fig. 17) resemble perfectly those in *Scotoplanes globosa*, the large straight spicula being very rare, but the C-shaped ones more numerous and close set. The last mentioned deposits are in this species usually slightly longer, more arcuated, and almost thread-like. The polian vesicle is small. The madreporic canal seems to open externally by a rounded pore; however, I have not been able to prove this.

Scotoplanes papillosa, Théel (Pl. II. figs. 5, 6).

Elpidia papillosa, Preliminary Report on the Holothuridæ, pp. 16, 17.

Body ovate, about once and a half as long as broad. Mouth anterior, terminal. Anus posterior, slightly dorsal. Tentacles of almost equal size, bearing at their terminal part numerous small digitiform processes. Pedicels eight along each side of the ventral surface. The dorsal surface with four small processes disposed in a transverse row a little in front of the middle of the back and united by their bases, forming a low ridge between the two ambulacra; and immediately behind this ridge another pair of small processes. Integument very thin, soft, and transparent, with small light papillæ, scattered on the back; calcareous deposits of two sorts: large straight spinose spicula, and small ones, more numerous and curved like a C.

Colour in alcohol, light grey. Length, 56 mm. Breadth, 34 mm.

Habitat.—Station 325. March 2, 1876. Lat. 36° 44′ S., long. 46° 16′ W. Depth, 2650 fathoms; bottom temperature, 0·4° C.; grey mud. One specimen.

The mouth is almost terminal, slightly bent towards the ventral surface, and is surrounded by tentacles of almost equal size; their terminal part, a little smaller than that of *Scotoplanes mollis*, is furnished with numerous retractile processes, and with a slight incision in its outer margin. Of the pedicels six pairs are of a conical form with a rather large base; whether the others, which are very small and insignificant, form two pairs or one only is difficult to decide, but I have thought the former to be the case. The transverse ridge on the dorsal surface is very low, crossing the odd interambulacrum from one radius to the other, and bears four small processes, of which the two in the middle are larger than the others, which are almost inconspicuous. Close behind this ridge each ambulacrum is provided with a minute process. The integument, very thin and transparent, is covered with papillæ of a more considerable size than those of *Scotoplanes mollis.* The ventral surface seems to be almost destitute of such papillæ. The calcareous deposits resemble those of the above-mentioned species; however, the C-curved ones seem frequently to be provided either with a small straight spine issuing from the middle or with a long curved arm, constituting thus a three-armed figure. The straight spicula are generally smaller on the ventral surface than on the dorsum, some of them being comparatively small and without spines.

From want of material, I have not been able to study more in detail the calcareous ring; it is only possible to state that it is composed, as usual, of five pieces (Pl. XXXVII. fig. 12), each consisting of a central part, from which radiate eight rather straight rods. But I have not been able to decide positively whether those pieces are separated from each other, or whether they are united by the ends of the rods, thus forming a perfect ring; I suppose the former to be the case. The polian vesicle is minute. The madreporic canal opens externally, 9 mm. behind the crown of tentacles. The reproductive organ consists of a single, rather large fascicle made up of a great many small close-set cæca.

It is obvious that the three forms *Scotoplanes globosa*, *S. mollis*, and *S. papillosa* are closely allied, and one is scarcely able to detect in the forms of the calcareous deposits any character to distinguish them from one another. On the contrary, the size, the position, and the form of the dorsal processes present, I believe, very good and constant specific characters. *Scotoplanes globosa* differs greatly from the two others in the form of the body, which, in consequence of the unusual convexity of the dorsal surface is more or less distinctly globular, while the body of the other two species is considerably more elongated.

Scotoplanes murrayi, Théel (Pl. III. figs. 3, 4).

Elpidia murrayi, Théel, Preliminary Report on the Holothuridæ, p. 16.

Body ovate, about twice as long as broad. Mouth anterior, subventral. Anus posterior, terminal. Tentacles of nearly equal size; the middle ventral one a little smaller than the others; their terminal part provided with small, digitiform, retractile processes. Pedicels short, five along each side of the ventral surface. The dorsal surface with three small processes, as long as half the breadth of the body or shorter, disposed on each of its ambulacra; the posterior pair rudimentary. Integument brittle and glassy from numerous crowded spicula, covering one another, some small and in the form of a C, others large, unbranched, straight, and very spinose.

Colour in alcohol glassy. Length, about 20 mm. Breadth, about 10 mm.

Habitat.—Station 152. February 11, 1874. Lat. 60° 52′ S., long. 80° 20′ E. Depth, 1260 fathoms; diatom ooze. One specimen.

I regret that but one specimen of this very pretty little species should have been obtained. It closely resembles, in general form, the typical *Elpidia glacialis*. The back is extremely convex. Some of the tentacles (Pl. XLIV. fig. 4) are evidently smaller than the others, which is especially the case with the middle one on the ventral surface, and the second one counting from that to the right. The processes on the dorsal surface are arranged so that the first pair is situated on the anterior part of the body, the second one on its posterior part, and the third rudimentary one immediately behind the second. The processes of the two first pairs measure about 3 mm. in length. The pedicels, as well as the tentacles and processes, are brittle and fragile on account of the large, slightly curved, generally spinose and transversely placed spicula. As in *Elpidia glacialis*, the ends of the pedicels as well as the minute processes of the tentacles are completely retractile and, as it seems, destitute of deposits. The integument is brittle, rough, and glassy; it contains quantities of close-set, straight, or curved spicula (Pl. XXXIV. fig. 2), measuring in length about 0·8 mm., and provided with large spines. Between those large spicula are to be distinguished small C-curved bodies, measuring about 0·13 mm. in length or sometimes less. Those last-mentioned deposits change considerably in size, but principally in form, some being extremely and equally arcuated, others being very slightly curved, while others, lastly, are almost perfectly straight, excepting their two nearly evenly arcuated ends. A series of dark spots appears on the dorsal surface, which, however, does not seem derived from pigment in the integument, but from some internal objects. Only a single specimen having been at my disposal, and that a very small one, it has not been possible to study any of the internal organs.

Scotoplanes albida, n. sp.

Body elongated, about twice as long as broad. Mouth anterior, terminal. Anus posterior, dorsal. The terminal part of the tentacles circular discoidal, unusually large, provided with small retractile processes. The dorsal surface with some small processes on its anterior part. Pedicels very long, ten or eleven (?) along each side of the ventral surface. Integument thin and soft, with two sorts of numerous calcareous deposits: small spicula, curved in the form of a C; and large, straight, spinose ones.

Colour in alcohol, white. Length, about 75 mm. Breadth, about 35 mm.

Habitat.—Station 143. December 19, 1873. Lat. 36° 48′ S., long. 19° 24′ E. Depth, 1900 fathoms; bottom temperature, 1·4° C.; globigerina ooze. One incomplete specimen.

Only a single specimen having been brought home by the Challenger Expedition, and that such an incomplete one as to render a detailed examination impossible, the description must necessarily be rather imperfect. The ventral surface is flat, the dorsal on the contrary convex. The anus is situated near the posterior end of the body, and is completely dorsal. The tentacles, of which only seven are left, have the terminal part very large, measuring about 10 mm. in diameter, and are furnished with a number of small-branched processes round the edge; besides those processes there are numerous very small papilla-like projections. Only some small processes have been discovered anteriorly on the dorsal surface, but how these are arranged I have not been able to observe. The pedicels are very large, measuring in length about 14 mm.; the posterior pairs are much smaller. The integument is thin and destitute of papillæ; the calcareous deposits in the form of a C (Pl. XXXII. fig. 14) are numerous, varying in length from 0·056 mm. to 0·1 mm.; the straight spinose spicula are very thinly scattered, and about 0·57 mm. in length. The pedicels and tentacles contain C-curved bodies, as well as larger or smaller more or less arcuated spicula (Pl. XXXII. fig. 15) which are beset with spines towards the ends. Only a single polian vesicle is to be observed. The cloaca is very large, with a cæcal prolongation. The madreporic canal seems to be without deposits. The reproductive organ consists of a single, 15 to 20 mm. long, fascicle of numerous small cæca.

This species bears a strong resemblance to *Scotoplanes mollis* and *Scotoplanes papillosa*, but it differs from these especially by the number and size of the pedicels, as well as by the large end of the tentacles, which greatly exceeds in dimensions the largest known of these two species mentioned.

Scotoplanes robusta, n. sp. (Pl. VI.).

Body elongated, widest a little in front of its middle, about twice and a half as long as broad. Mouth anterior, subventral. Anus posterior, dorsal. Tentacles of almost equal size; their large, thick, and sole-like terminal part contracted, only two processes being visible in its outer margin. Pedicels, eleven along each side of the posterior half of the ventral surface; the anterior part of that surface destitute of pedicels. The dorsal surface with three pairs of processes anteriorly; two larger, close-set, arranged in a transverse row, and the third pair small, placed a little behind those. Integument thin, with two sorts of calcareous deposits: large bodies composed of three long, straight spinose arms; and smaller ones, in the form of a C.

Colour in alcohol, light violet. Length, about 133 mm. Breadth, about 53 mm.

Habitat.—Station 157. March 3, 1874. Lat. 53° 55′ S., long. 108° 35′ E. Depth, 1950 fathoms; diatom ooze. One specimen.

The dorsal surface is extremely convex. The ventral surface is almost flat or slightly convex, and its anterior half is totally destitute of pedicels. The posterior pairs of pedicels are comparatively small. Four of the dorsal processes, being of a comparatively large size, are arranged in a transverse, slightly arcuated row between the two ambulacra, and situated 30 to 40 mm. behind the anterior extremity of the body; united together at their large base, they give the impression of running out from a low ridge; those in the middle are largest, measuring in length about 10 mm. The third pair of processes is placed a little behind the former ones, one on each ambulacrum. The calcareous deposits (Pl. XXXIV. fig. 6) are rather scattered in the integument, in consequence of which this becomes rather soft and pliable. The C-shaped bodies, measuring in length about 0·1 mm., are more crowded together than the three-armed ones, which are comparatively larger, each arm having a length of about 0·24 mm. The arms being more or less spinose and bearing in the middle some small spinose, outwardly directed processes, run out from a central point, thus forming with one another angles of equal size. The tentacles and processes (Pl. XXXIV. fig. 7) bear besides those C-curved deposits, straight or arcuated, branched or unbranched spinose spicula. The five pieces (Pl. XXXVII. fig. 9) constituting the calcareous ring, are separated from one another, and consist of eight rods, which, having their ends more or less branched, diverge from a common centre. The polian vesicle measures in length about 15 to 20 mm. The madreporic-canal opens exteriorly about 20 mm. behind the crown of the tentacles—that is to say, on the back almost in the middle between the tentacles and the transverse row of processes; its wall contains only a few C-shaped bodies. The alimentary canal is very thick and connected to the body-wall by elastic bands and threads; the cloaca fills up the whole posterior peritoneal cavity. The reproductive organ consists of a single considerable wide tube, narrowing anteriorly into an efferent duct, which opens at the top of a small papilla, situated immediately behind the pore of the madreporic canal. The tube bears numerous bundles of cæca, and its length is about three-fourths of the body.

Scotoplanes insignis, n. sp. (Pl. VII. figs. 1–3).

Body elongated, of almost equal breadth, about twice and a half as long as broad, considerably depressed posteriorly; its posterior flat end deeply incised in its middle.

Mouth anterior, ventral. Anus posterior, dorsal. Tentacles of almost equal size, some of the ventral ones a little smaller; their terminal part large, brown, contracted. The dorsal surface with three small processes in a transverse row anteriorly, and a little behind those are two other ones, smaller, placed one on each ambulacrum. Pedicels, eleven along each side of the ventral surface. Integument thin, soft, transparent; calcareous deposits of two sorts: large three-armed spinose bodies; and small ones, in the form of a C.

Colour in alcohol, white. Length, about 50 to 60 mm. Breadth, about 24 mm.

Habitat.—Station 156. February 26, 1874. Lat. 62° 26′ S., long. 95° 44′ E. Depth, 1975 fathoms; diatom ooze. One specimen.

The only specimen I have had at my disposal is, as the figures show, considerably contracted, wherefore the form of the body evidently must have been different in the living state of the animal. The dorsal surface is extremely convex anteriorly, and posteriorly approaches gradually to the ventral, almost flat surface, so that the hindmost part of the body becomes strongly depressed. The greatest height of the body is immediately behind the crown of tentacles. For the rest, the body is of almost equal breadth, rounded anteriorly, but having its posterior extremity truncated and deeply incised in the middle. The species evidently bears a certain resemblance to *Elpidia willemoësi* as regards the external form of the body. The mouth is completely ventral, but there is no doubt that its position must change when the body is extended to its natural form. The anus is large and dorsal in aspect, situated immediately behind the above-mentioned incision. The six anterior pairs of pedicels on each side of the ventral surface are distinctly separated from each other, the first being situated at some distance behind the crown of tentacles. The others, which are directed backwards and closely crowded side by side, are webbed together by an extension of the integument, only their tops being free; these five united pedicels form a thin fin-like lobe on each side of the above-mentioned incision. In fact, the arrangement of the pedicels resembles considerably that of *Elpidia willemoësi.*

In consequence of the strong convexity, which is probably derived from the contraction, to which I have alluded above, the foremost part of the dorsal surface is turned downwards, and this very part bears the five small processes, of which three are situated in a transverse row a little before or rather below the other two. The ends of the tentacles are large, of a brownish colour, and so strongly contracted that no processes are visible; only on the outer margin is it possible to observe traces of two such. The calcareous deposits (Pl. XXXIII. fig. 7) resemble most strikingly those of *Scotoplanes robusta.* The three-armed bodies consist, as in that species, of three straight, spinose, long arms, measuring about 0·2 mm. in length, which run out from a common centre, and form with each other three angles of equal size; those deposits are very thinly scattered in the integument, while the more or less strongly C-shaped ones are much more numerous, but measuring in length only about 0·12 mm. The ends of the pedicels and tentacles have a number of straight or slightly curved, more or less spinose spicula.

Tabular View of Species of the Genus Scotoplanes.

- I. Pedicels all along each side of the ventral surface.
  - A. Body elongated, posteriorly extremely depressed with the flat truncated posterior end deeply incised in its middle. Calcareous deposits: C-shaped spicula and three-armed bodies, ... *Scotoplanes insignis.*
  - B. Body more or less elongatedly ovate or almost globular. Calcareous deposits: C-shaped spicula, and large, straight, unbranched ones.
    - *a.* Perisoma brittle and glassy, ... *Scotoplanes murrayi.*
    - *b.* Perisoma thin, soft, and pliable.
      - 1. Pedicels seven along each side of the ventral surface. Dorsal surface, with three pairs of processes, the two first pairs being very large and elongatedly conical, ... *Scotoplanes globosa.*
      - 2. Pedicels six along each side of the dorsal surface. Dorsal surface, with two very large elongatedly conical processes side by side near its middle, and with two smaller ones issuing one from the outer side of each of the former, ... *Scotoplanes mollis.*
      - 3. Pedicels eight along each side of the ventral surface. Dorsal surface, with a low transverse ridge near the middle, bearing four very small processes, and with two rudimentary processes behind this ridge, . *Scotoplanes papillosa.*
      - 4. Pedicels ten or eleven along each side of the ventral surface. Dorsal surface, with some small processes anteriorly, . . *Scotoplanes albida.*
- II. Pedicels only around the posterior half of the ventral surface. Calcareous deposits: C-shaped spicula and three-armed bodies, ... *Scotoplanes robusta.*

Irpa, Danielssen and Koren.

Irpa, Dan. and Kor., Nyt Magazin for Naturvidenskaberne, xxiv. 3, 1877.

Irpa abyssicola, Danielssen and Koren.

Body elongated, nearly cylindrical, about thrice and a half as long as broad. Mouth anterior, almost terminal. Anus posterior, terminal subdorsal. Tentacles of almost equal size; their terminal part, with small digitate processes. Pedicels cylindrical, twelve along each side of the ventral surface. The dorsal surface, only in its anterior third, with two anteriorly diverging rows of processes, four in each, and with two slightly larger processes between the two rows. Integument leathery, with two sorts of calcareous deposits: scattered small, straight or curved horseshoe-shaped spinose spicula, rarely provided with some branches; and numerous very small elliptical bodies.

Length, about 21 mm. Breadth, about 6 mm.

Habitat.—Station 35. Lat. 63° 22′ N., long. 1° 20′ W. Depth, 1050 fathoms; bottom temperature, 1·3° C.; grey-brown mud. One specimen dredged by the Norwegian North Atlantic Expedition.

Kolga, Danielssen and Koren.

Kolga, Dan. and Kor., Nyt Magazin for Naturvidenskaberne, xxv. 2, 1879.

Kolga hyalina, Danielssen and Koren.

Body elongatedly oval, thrice to thrice and a half as long as broad. Mouth anterior, ventral. Anus posterior, dorsal. Tentacles of almost equal size; their terminal part with small digitate processes. Pedicels large, seven to nine along each side of the ventral surface. The foremost part of the dorsal surface, with six small processes close-set in a row on a low, slightly curved transverse ridge; the two middle ones a little larger. Integument very thin and transparent, with several sorts of calcareous deposits: minute unbranched, more or less spinose and irregularly curved, often horseshoe-shaped spicula; larger ones more or less curved, spinose, and not very seldom with longer and shorter branches; bodies having the form of network and of small rosettes.

Length, about 50 mm. Breadth, about 12 to 15 mm.

Habitat.—Station 295. Lat. 71° 59′ N., long. 11° 40′ E. Depth, 1110 fathoms; bottom temperature, 1·3° C. Biloculina mud. Station 303. Lat. 75° 12′ N., long. 3° 2′ E. Depth, 1200 fathoms; bottom temperature, 1·6° C.; brown mud.

This form differs, however, in several other characters of more or less importance from the preceding one, as, for instance, in the construction of the calcareous ring, &c.; but the greatest difference is in regard to the madreporic canal, which communicates with the exterior in *Kolga*, while its extremity is united with the inside of the body-wall in *Irpa*.

Kolga nana, Théel (Pl. II. figs. 3, 4).

Elpidia nana, Théel, Preliminary Report on the Holothuridæ, pp. 15, 16.

Body elongatedly ovate, from twice and a half to thrice as long as broad. Mouth anterior, terminal, slightly ventral. Anus posterior, subdorsal. Tentacles of equal size; their terminal part bearing several small, digitate, retractile processes. Pedicels eight or nine along each side of the ventral surface. The dorsal surface with three pairs of small processes anteriorly, close-set in two rows, converging forwards. Integument thin and transparent, with two sorts of calcareous deposits: numerous minute, unbranched, more or less irregularly curved, frequently horseshoe-shaped spicula, provided with some small spines; and very few bodies in the form of a network.

Colour in alcohol, light grey or white. Length, about 16 mm. Breadth, about 5 mm.

Habitat.—Station 50. May 21, 1873. Lat. 42° 8′ N., long. 63° 39′ W. Depth, 1250 fathoms; bottom temperature, 2·8°; grey ooze. Several specimens.

Station 152. February 11, 1874. Lat. 60° 52′ S., long. 80° 20′ E. Depth, 1260 fathoms; diatom ooze. One incomplete individual.

The above specific characteristics chiefly refer to the individuals from Station 50; the only specimen obtained from Station 150, which I have had at my disposal, was most incomplete; it differs in some ways from those of the first-mentioned station, and will, when compared with individuals in a more complete state, possibly prove to belong to another species differing from this one. The want of necessary materials, and the strong general resemblance it bears to this species, induce me to leave it here provisionally; but I intend, after having first given a more detailed account of the typical form, to point out by what this one is distinguished. A short time after my Preliminary Report on the Holothuridæ of H.M.S. Challenger had been communicated to the Royal Swedish Academy of Science,. and before it was printed, I received from Drs Danielssen and Koren their report upon the Echinoderms of the Norwegian North Atlantic Expedition, in which a new Holothurian, *Kolga hyalina*, is described most carefully; this species bears a strong resemblance to *Kolga nana*, described by me, and at first I considered the two forms to be identical. From want of material I have not had the opportunity of making comparisons,and, as several differences exist, I have preferred to keep *Kolga nana* in the meantime as a separate species.

All the specimens which have been brought home by the Challenger expedition are more or less injured, the most of them being torn in pieces, consequently they are neither suitable for determining the outer form, nor for rendering an examination of the inner organs possible. The body is elongated, ovate, and reaches its greatest breadth at the middle or a little behind it; its posterior extremity is evenly rounded, while the anterior one is almost truncated; the mouth and tentacles are terminal, indistinctly bent towards the almost flat ventral surface. The dorsal surface is not very strongly convex, the breadth of the body being always greater than the height. The ends of the tentacles are divided by some small incisions round the edge into four or five small processes or lobes, each carrying some smaller retractile branches; in most cases, the terminal part being retracted, only one or two processes are to be seen. The processes of the dorsal surface are small, decreasing in size backwards, so that the last pair is minute; sometimes four pairs of processes are to be observed instead of three, which seems to be the ordinary number. As they are usually crowded in each row, and webbed together at the base, they appear to project from a low ridge, caused by the contraction of the animal; some fully extended specimens seem, however, to have the processes at some distance from each other and projecting directly from the body-wall. The pedicels are eight or in most cases nine in number along each side of the ventral surface; the posterior pairs are always considerably smaller. Among the calcareous deposits of the integument, the extremely arcuated spicula (Pl. XXXIV. fig. 5), often almost curved in the form of a ring, are especially numerous, but very small and insignificant, and slightly enlarged in their middle; they are partly scattered, partly aggregated, and generally provided with spines. The plates, on the contrary, are perforated so as to resemble a network, and comparatively large, about 0·14 mm. in diameter; they are very scattered, and consequently difficult to detect; every here and there in the integument of the body some larger, straight and more spinose spicula are to be observed. The processes, the pedicels, and the tentacles contain a number of smooth, spinose, rather large, more or less fusiform, or slightly curved spicula.

According to my observations, each of the five pieces of the calcareous ring consists of a central part, from which issue in opposite directions ten rods, five towards each side; their terminal part is flattened and expanded. From want of material I have not been able to give any figure of the ring. The polian vesicle seems to be inconsiderable. The madreporic canal appears to be destitute of deposits and opens externally a little in front of the dorsal processes. The posterior part of the alimentary canal dilates into a large cloaca, which runs out from the left side into a considerable prolongation, directed forwards. In regard to the number of the ambulacral canals of the water-vascular system, which I have found to be five in all forms of the order Elasipoda, but which Danielssen and Koren state in the species *Kolga hyalina* to be only two, I refer to the anatomical part of my report. All along each side of the ventral surface are to be seen some small globular vesicles attached to the nerve-cords; these measure about 0·14 mm. in diameter and are disposed one at each nerve-branch which is given off to the pedicels, two a little before the first pair of pedicels, and two between the first and the second pair of pedicels. Several such auditory vesicles are doubtless to be found on the nerve-ring, though from want of material they have escaped me; as in *Elpidia glacialis* and several other species, their position seems to vary a little. They are lined internally by a layer of large cells, and contain up to twenty minute, oblong otoliths (Pl. XXXVI. fig. 25), measuring about 0·028 mm. in length, their wider end being rounded and the opposite one truncated. The reproductive organ consists of a fascicle composed of two bundles of small cæca; the organ opens immediately behind the pore of the madreporic canal.

When comparing the above-described species and that of Danielssen and Koren with one another, one finds that the latter is distinguished by the following characters:—The processes of the dorsal surface, six in number, project from a continuous, transverse, slightly curved ridge; the mouth is ventral and the number of pedicels varies from fourteen to eighteen; besides smaller and larger, unbranched and arcuated spicula, resembling those of *Kolga nana*, there are also to be discovered rather large and branched ones, and, though exclusively in the oral disk, some small rosette-shaped bodies together with some net-like perforated plates; each of the five pieces constituting the calcareous ring gives off fourteen rods, seven towards each opposite side, four of which are always longitudinally split; the auditory vesicles are twenty-six in number, and the otoliths of each auditory vesicle vary from about twenty to one hundred and thirty.

I shall now give an account of the characters which distinguish the individual dredged at Station 152 from the typical *Kolga nana*. The form of the body of this animal, as well as the position of the mouth, agree in most part with those of *Elpidia glacialis*. The length is about 28 mm. and the breadth about 14 mm. The pedicels are nine along each side of the ventral surface. From the incomplete state in which this individual was found, it is not possible to give a more detailed description of the dorsal processes; they seem, however, to be very insignificant, four in number, and evidently arranged in a transverse row, those in the middle being largest. The calcareous deposits (Pl. XXXIII. figs. 1, 2) of the integument consist exclusively of numerous, minute spicula provided with some small spines and with an enlargement in the middle; they are either almost straight, or extremely arcuated, horseshoe-shaped, or curved so as to form an angle. The perisoma seems to be destitute of net-like perforated plates, but, as they are much scattered in the typical form, they may have possibly escaped my observation.

The typical form is found in the North Atlantic Ocean near Halifax, while the other lives not very far from the Antarctic circle; whether these two forms prove to be long to the same species, or, though very closely allied, are distinct, the great distance of those localities are always interesting. This is not the only example among the Holothurids from the great depths of the sea, where representatives of the same species or at least of the most nearly allied forms are found in or near the Arctic Sea and also in the neighbourhood of the Antarctic Ocean.

Peniagone,[1] n. gen.

Body more or less elongated, sometimes depressed posteriorly or with a narrow neck-like part anteriorly. Tentacles ten. The dorsal surface with a larger or smaller, branched or unbranched lobe-like appendage anteriorly, and commonly with some more or less minute processes. The ventral surface with pedicels all along each side, or only round its posterior half or third. Integument with several sorts of calcareous deposits: four-armed bodies with one to four processes; and three-armed ones together with branched or unbranched spicula and small bodies curved in the form of a C.

Peniagone wyvillii, n. sp. (Pl. X. figs. 3, 4).

Body slightly depressed, about twice as long as broad, broadest in its anterior part. Mouth anterior, ventral. Anus posterior, terminal. The terminal part of the tentacles large, provided with small, branched, retractile processes. Pedicels about eight (?) along each side of the ventral surface; the anterior part of the ventral surface destitute of pedicels. The dorsal surface with an extension of the skin anteriorly constituting a large, very broad, transverse lobe, bearing four rather large branches or processes in its upper margin; and having immediately behind that lobe two small, rudimentary processes on each ambulacrum. Integument very thin and transparent, with calcareous deposits, composed of a long, thin central part and two slightly arcuated arms, diverging from each of its ends; each arm with a large process, directed outwards.

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[1] Πενία = poverty.

Colour in alcohol, light grey, inclining to violet, here and there a little darker; tentacles, the oral disk and the nerve cords almost black violet. Length, about 60 or 70 mm. Breadth, about 35 mm.

Habitat.—Station 271. September 6, 1875. Lat. 0° 33′ S., long. 151° 34′ W. Depth, 2425 fathoms; bottom temperature, 1·0° C.; globigerina ooze. One very incomplete specimen.

The only individual of this species, which has been obtained by the Challenger expedition, is extremely incomplete; it wants some of the pedicels, parts of the body-wall, the madreporic-canal, and the water-vascular ring; consequently my description must be very unsatisfactory. To give an idea of the form of this species, it has been necessary to draw the figures in accordance with my opinion of its probable appearance, hence it is possible that I may have made some mistakes. Only five rather large pedicels are left along each side of the body-wall, and two extremely minute ones at the posterior end of the body; the rest are torn off, and eight, the number mentioned above, may be wrong. All the tentacles (Pl. XLIV. fig. 5) are broken, except a single one, which has the terminal part beset with a number of small rather branched, and retractile processes, two of which are largest; those processes are provided with a number of retractile, branched or unbranched, cylindrical papillæ (Pl. XLIV. fig. 7) the extremely thin walls of which seem to be destitute of deposits. The large, and broad four-branched appendage on the anterior part of the back is made up of four large and long processes, which are arranged in a transverse row, and are webbed together by an extension of the integument leaving only their upper half free. These free ends, of which the two middle ones are largest, appear to be of an elongated conical form though rather flattened. These processes are in connection with large, elongated ambulacral cavities, of which those communicating with the largest middle processes are situated a little in front of the other ones. The appendage is very flexible and seems capable of being directed upwards, as well as of being bent downwards and forwards, thus covering the tentacles. The thin and transparent integument is covered with small papillæ, each containing a calcareous deposit of the above-mentioned shape. The four processes, running out one from each arm, are situated close to the elongated central part of the deposits. As the calcareous deposits are mostly dissolved and only the surrounding membranes are left, it is impossible to decide whether the arms and the processes are spinose or not.

The madreporic canal communicates with the exterior by a pore, situated a little above the crown of tentacles; it is invested by a thick sheath of connective tissue, which increases gradually towards the body-wall. The individual which has been at my disposal has lost the reproductive organ, except the efferent duct, which is surrounded by the same sheath which encloses the madreporic canal. This common efferent duct (Pl. XXXVII. fig. 6) is very remarkable from its dividing into two short and wide canals, which diverge towards the body-wall, where each divides into about eight divergent long and very narrow canals; those canals make some coils in the layer of connective tissue of the body-wall before they reach the apertures by which they open externally and which are placed far apart. Those secondary canals, carrying sometimes one or two branches, diverge greatly from each other, and some of them extend beyond the two dorsal ambulacra, consequently several of their openings lie in the lateral interambulacra.

Peniagone lugubris, n. sp. (Pl. X. fig. 1).

Body elongated, three or four times as long as broad. Mouth anterior, ventral. Anus posterior, subdorsal. The terminal part of the tentacles large, provided with small retractile processes. Pedicels about five along each side of the ventral surface; the anterior third of the ventral surface destitute of pedicels. The dorsal surface with an extension of the skin anteriorly constituting a very large, broad, transverse lobe, bearing four rather small processes on its upper margin. Integument rather hard, with a great number of crowded calcareous deposits, composed of a slightly elongated central part, and two arcuated arms, diverging from each of its ends; each arm with a large process, directed outwards.

Colour in alcohol, black-violet; the ends of the tentacles almost black. Length, about 70 or 75 mm. Breadth, about 15 or 20 mm.

Habitat.—Station 104. August 23, 1873. Lat. 2° 25′ N., long. 20° 1′ W. Depth, 2500 fathoms; bottom temperature, 1·7° C.; grey ooze. One incomplete specimen.

The dorsal surface is convex, the ventral, on the contrary, almost flat. Anteriorly, above the tentacles, where the body attains its greatest height, the dorsal surface is provided with a very large, comparatively flat appendage, which measures in length about 40 mm. The free end of this appendage is broad and slightly rounded, and its base seems to be considerably broader than the body itself. This lobe, which has a transverse position, crossing from one side of the body to the other, divides the dorsal surface into a more or less horizontal, posterior part, and an anterior almost vertical part. The appendage carrying four small, obtuse projections or processes on its upper rounded margin, is traversed by four long and very wide canals tapering upwards, and each of them entering one of the above-mentioned projections. As those canals are visible to the naked eye through the walls of the lobe, the whole dorsal appendage gives the impression of being constituted by four long, conical processes, webbed together by an extension of the skin. The lobe seems to possess a high degree of flexibility, and doubtless it can be thrown upwards and backwards as well as turned over the mouth and the tentacles. The skin of this specimen being very contracted and wrinkled, it is not possible to decide with certainty whether or not the dorsal surface is provided with some other minute processes. The mouth is perfectly ventral and surrounded by ten tentacles, of which only a few are left; they seem mostly to resemble those of *Peniagone wyvillii.* The pedicels appear to be five or six in number on each side, of which as usual the anterior ones are slightly larger and further apart from each other than the posterior ones. The calcareous deposits have the aspect of being very closely crowded together within the integument, and bear a strong resemblance to those of the above-mentioned species; their arms, measuring in length from 0·06 to 0·08 mm., are slightly curved and, as is the case with the four processes, minutely spinose.

The characters which distinguish this species from the preceding one are the following:—The almost black colour, the large rounded dorsal appendage, the more cylindrical form of the body, the number of pedicels, and lastly the abundance of calcareous deposits.

Peniagone horrifer, n. sp. (Pl. X. fig. 2).

Body elongated, about thrice as long as broad. Mouth anterior, ventral. Anus posterior, terminal; tentacles very long, their large terminal part with small, branched, retractile processes. Pedicels about eight along each side of the ventral surface; the anterior half of the ventral surface destitute of pedicels. The dorsal surface having an extension of the skin anteriorly, constituting a very large, flattened, almost triangular lobe, with its base in the direction of the medio-dorsal line, and with four rather large, flat, obtuse projections along the right side of its upper or rather posterior dilated concave margin; and bearing near the base of that lobe some other small papilla-like processes. Integument thin, with a great number of crowded calcareous deposits, composed of four arcuated, slightly spinose arms, diverging from the ends of a more or less elongated central part, and two to four rather long, straight spinose processes, directed outwards.

Colour in alcohol, light violet. Length about 85 to 90 mm. Breadth about 30 to 35 mm.

Habitat.—Station 157. March 3, 1874. Lat. 53° 55′ S., long. 108° 35′ E. Depth, 1950 fathoms; diatom ooze. One very incomplete specimen.

It is a great pity that I have had the opportunity of examining only a single individual of this very interesting species, and that this like the preceding forms has changed so considerably during the preservation in spirit, that it has been almost impossible to form any correct idea of its true aspect. The dorsal surface is strongly convex, the ventral surface being on the contrary flat. The large characteristic appendage of the dorsal surface has a more or less marked triangular shape, and is compressed from the sides as to form a more or less flattened lobe; its broad base is in the direction of the medio-dorsal line of the body, while the contrary takes place in *Peniagone lugubris* and *Peniagone wyvillii*. A glance at the figure will give an idea of its form and position, as I have thought them to be. The anterior side of the lobe is more or less curved, and almost vertical, and passes immediately into the anterior downwardly directed part of the dorsal surface. Its posterior side, on the contrary, which inclines obliquely downwards and backwards, is significantly dilated and considerably depressed along its middle so as to form two margins, of which the right one sends out four flat, obtuse projections, the uppermost of these forms the top of the lobe. The height of the appendage is about 35 mm. Posteriorly, almost at the base of the lobe are to be observed one or several very small processes, the correct number of which it is difficult to determine. The tentacles, of which but few remain, seem to be almost equally large; when extended, they are very long, measuring about 22 mm. Their large terminal part recalls the preceding species by having, especially round the edge, some branched retractile processes, of which two on the outer margin are largest. The inner side of the processes, as well as a great part of the ends of the tentacles, carry a number of small, retractile, papilla-like projections. Only the posterior half of the ventral surface is provided with eight or nine pairs of pedicels, the posterior ones attaining a comparatively inconsiderable size. The calcareous deposits (Pl. XXXIII. fig. 9), which are visible in great abundance within the perisoma, seem to resemble in form those of *Peniagone lugubris*, though varying generally more than those in shape as well as in size. The largest deposits have the arms measuring about 0·1 mm. in length and often considerably arcuated; sometimes the arms seem to exceed four in number. The processes are generally very long, and vary between two and four; in the former case the deposits seem to be slightly smaller, and their processes issue from the ends of their more or less elongated central part; in the latter case one process proceeds from each of the four arms, near their attachment to the central part. The ends of the pedicels as well as of the tentacles contain partly simple or branched more or less arcuated spicula, partly four-armed deposits without processes, and with the arms often unequal and more or less irregularly curved (Pl. XXXIII. fig. 8). It has been impossible to subject the calcareous ring to a closer examination, but, judging from what I have seen, it does not differ in any striking manner from the ordinary form in this family. Two polian vesicles, measuring from 10 to 15 mm. are present. The reproductive organ consists of a number of large, thick bundles of cæca, which open into two particularly wide tubes, which communicate with a single, very wide efferent duct narrowing anteriorly. The alimentary canal is retained in its proper position by elastic bands or threads; a mesenteric membrane only occurs anteriorly, uniting the foremost part of the alimentary canal and the duct of the reproductive organ with the medio-dorsal line of the body-wall.

Peniagone atrox, n. sp. (Pl. X. fig. 5).

Body elongated, about thrice as long as broad. Mouth anterior, ventral. Anus posterior, dorsal. The terminal part of the tentacles large, discoidal, with small, branched, retractile processes. Pedicels about 5 (?) along each side of the ventral surface. The anterior half of the ventral surface destitute of pedicels. The dorsal surface having an extension of the skin anteriorly, constituting a long, but not very broad, flattened, transverse lobe, with the free end rounded and the posterior surface concave. Integument with a great number of crowded calcareous deposits, composed of a slightly elongated central part, and two more or less curved arms, diverging from each of its ends; each arm with a process, directed outwards; the length of the arms and processes extremely variable.

Colour in alcohol, light grey. Length about 100 mm. Breadth about 33 mm.

Habitat.—Station 160. March 13, 1874. Lat. 42° 42′ S., long. 134° 10′ E. Depth, 2600 fathoms; bottom temperature, 0·2° C.; red clay. One incomplete specimen.

The dorsal surface is extremely convex, and its odd interambulacrum is divided by a long and transverse appendage into a posterior, nearly horizontal part, and an anterior part sloping downwards. The ventral surface is more or less evidently flat. The anus is situated upon the dorsal surface. The dorsal appendage attains a length of 35 or 40 mm. and is flattened, its anterior surface being convex, the posterior one, on the contrary, almost concave; its upper part is evenly rounded without any distinguishable processes. The integument seems to form a thin, rather broad fold or brim, along the left dorsal ambulacrum, but I dare not say with certainty whether the animal really possesses it when living, or whether it has originated from an accidental contraction. Only two of the tentacles remain. The calcareous deposits (Pl. XXXIII. fig. 5) of the integument vary greatly as well in form as in size; some of them have their comparatively slender arms very long, measuring about 0·12 mm., spinose, more or less curved, and provided with a short spinose process; others resemble those, though their arms are considerably thicker, and measure only 0·04 mm. in length. Most of the deposits are very small, with their spinose arms extremely short and obtuse, measuring about 0·016 mm., and with their processes of almost the same length and form as the arms, consequently it is almost impossible to distinguish them from each other. The deposits in the ends of the pedicels as well in the tentacles resemble those of the preceding species.

Peniagone naresi, n. sp. (Pl. IX. figs. 1, 2).

Body more or less elongated. Mouth anterior, subventral. Tentacles of almost equal size; their terminal part with a number of small, retractile processes. The dorsal surface having a large extension of the skin anteriorly, constituting a high, flattened, flexible, transverse lobe with four distinct projections on its upper margin, and with two very small ones posteriorly at its base. Integument very thin, transparent, with three sorts of calcareous deposits numerous: large and small, spinose, three-armed bodies; unbranched or irregularly branched, spinose spicula; and small spicula, curved in the form of a C.

Colour in alcohol, light violet. Breadth about 15 to 17 mm.

Habitat.—Station 158. March 7, 1874. Lat. 50° 1′ S., long. 123° 4′ E. Depth, 1800 fathoms; bottom temperature, 0·3 C.; globigerina ooze. One incomplete specimen.

As the posterior part of the body is torn off in this very interesting and characteristic species, it is quite impossible to determine the length of the body, the position of the anus, or the number of the pedicels. The remaining part of the body measures about 35 mm. in length. Anteriorly, where the large dorsal appendage arises, the body reaches its greatest height, and from that point the dorsal surface is almost vertically bent down towards the tentacles. The dorsal surface is extremely convex, the ventral, on the contrary, is almost flat or slightly convex, the breadth of the body seems to be almost equal throughout. The circular ends of the tentacles are large and sole-like. Only six pairs of pedicels remain, the first one arising close to the tentacles; their form is conical, strongly tapering towards the ends, which present a small sole-like enlargement. The dorsal appendage is of considerable size, measuring about 25 to 30 mm. in length, broad superiorly, and almost flat; its inferior part, on the contrary, is a little narrower, and has the posterior surface grooved in the form of a gutter. Of the four projections in the upper free margin of the lobe the two in the middle are largest. The whole lobe of this specimen is constituted, like that of the preceding species provided with such appendages, by four long processes which, communicating with the dorsal ambulacra, are webbed together by an extension of the integument, leaving only their tops free. The integument is very transparent, and the strongly pigmented ambulacra, as well as the nerve-cords and the ambulacral cavities are plainly visible through it. The form and the size of the calcareous deposits (Pl. XXXIII. fig. 15) vary greatly. The large three-armed bodies are more scattered in the integument, and have their arms straight, spinose, and measuring about 0·22 mm. The small three-armed deposits, on the contrary, are very crowded, and their arms, measuring only about 0·06 mm. in length, are provided with conspicuously large spines; the difference between these two deposits is thus striking. The arms are generally straight and, arising from a common centre, form with each other angles of almost equal size; but it is necessary to add that many exceptions are found, some arms being more or less irregularly curved, and consequently the angles being of unequal size. The spicula unbranched, or sometimes which are provided with one or several branches, are very scattered and strongly spinose. The small C-shaped spicula, attaining a length of about 0·068 mm., present an enlargement in the middle, the existence of which seems to be common to all deposits of this kind. Their degree of curvature is rather variable; sometimes, though rarely, an arcuated arm projects from the middle of the convex side, sometimes its C-shape is changed into the form of an S.

Peniagone challengeri, n. sp. (Pl. IX. figs. 6–8).

Body elongated, of almost equal breadth throughout, about five times as long as broad, depressed posteriorly; its posterior flat extremity with an incision in its middle. Mouth anterior, ventral. Anus posterior, dorsal. Tentacles of almost equal size; their discoidal, terminal part with small retractile processes. Pedicels eight or nine along each side of the ventral surface; the anterior half of that surface destitute of pedicels. The dorsal surface having anteriorly an extension of the skin, constituting a long, broad, flattened, obliquely transverse lobe, with two rather considerable projections in its upper margin. Integument rather hard and rough, with numerous, crowded calcareous deposits, composed of a slightly elongated central part, and two more or less curved spinose arms diverging from each of its ends; each arm with a spinose process, directed outwards; the length of the arms and processes extremely variable.

Colour in alcohol, light grey, inclining to violet. Length, about 65 mm. Breadth about 13 mm.

Habitat.—Station 158. March 7, 1874. Lat. 50° 1′ S., long. 123° 4′ E. Depth, 1800 fathoms; bottom temperature, 0·3° C.; globigerina ooze. Two specimens.

As the above dimensions indicate, the body, being of equal breadth throughout, seems very narrow in comparison to its length. It attains its greatest height a little behind the tentacles and immediately in front of the large appendage, which divides the dorsal surface into a posterior part, which is slightly convex and gradually approaches the ventral surface posteriorly, and into an anterior, extremely convex part. The large anus is situated on the dorsal surface a little in front of the incision. The dorsal appendage, measuring about 22 mm. in length and about 12 mm. in breadth at the base, crosses obliquely from one side of the dorsal surface to the other, so that while the base at the right side is found at a distance of about 20 mm. from the anterior extremity of the body, this distance at the left side, on the contrary, amounts only to about 11 mm. The upper edge of the lobe is deeply emarginated so as to form two rather slender processes, 8 to 10 mm. long, the right one being a little the larger. The tentacles, of which four are torn off, appear to be of almost equal size; their terminal part is large and discoidal, and of the small retractile processes the two on the outer edge have the appearance of being the largest. The five anterior pairs of pedicels are large in comparison to the posterior ones and separated from each other at certain distances; the seven remaining pedicels, which run out from the flat, truncated posterior end of the body are small and directed backwards, very closely crowded, and disposed four on the right side of the above-mentioned incision, and three on the left. The calcareous deposits (Pl. XXXIII. fig. 16) vary greatly in size. The arms of the largest scattered ones measure about 0·12 mm.; the small ones, on the contrary, are considerably more numerous, and have the arms about 0·036 mm. in length. There are many forms between those two extremes. In the small deposits, the processes run out from the very base of the arms, whereby those calcareous bodies have the appearance of consisting of four arms diverging from each end of the more or less elongated central part. Here and there some very small bodies have been found destitute of spines and processes.

Peniagone vitrea, n. sp. (Pl. VII. figs. 7–9).

Body elongated, of almost equal breadth throughout, about thrice as long as broad; its foremost neck-like part narrow and bent downwards, forming almost an acute angle with the ventral surface. Mouth anterior, directed downwards. Anus posterior, dorsal. Tentacles of almost equal size; their terminal part with small, retractile processes. Pedicels eight pairs, disposed round the posterior third of the ventral surface; the anterior two-thirds of that surface destitute of pedicels. The dorsal surface with a broad, not very high, flat, transverse lobe anteriorly, with four projections in its upper margin, the middle ones being considerably the larger; behind that lobe are two very small processes on each ambulacrum. Integument extremely hard, brittle, and very rough, with numerous calcareous deposits, composed of four long, more or less curved, slightly spinose arms, and one to four straight, spinose, rather long processes, directed outwards.

Colour in alcohol, white and glassy. Length, about 60 mm. Breadth, about 20 mm.

Habitat.—Station 302. December 28, 1875. Lat. 42° 43′ S., long. 82° 11′ W. Depth, 1450 fathoms; bottom temperature, 1·5° C.; globigerina ooze. Several specimens.

The shape of the body seems to be very peculiar, and at first sight one is almost tempted to consider the dorsal surface to be the under side of the body and contrariwise. It is possible that the individuals of this species may in their living state differ in shape from that described above, but of course one cannot be quite sure of their true aspect from the examination of specimens much deformed by preservation in spirit. That which seems most doubtful is whether the narrow neck-like part of the body is really bent downwards as much as my figures show. Anyhow, I am obliged to take the above description of the form of the body for granted, especially as it accords with the figures which were drawn from fresh materials during the voyage of H.M.S. Challenger. The breadth of the body, almost equal to the height, has the appearance of being equal or slightly greater anteriorly. The broad dorsal appendage divides the odd interambulacrum into two parts: a posterior, almost horizontal and slightly convex one, which extends almost the whole length of the animal; and an anterior shorter and curved one, which is turned downwards and slightly backwards so as to form an almost obvious angle with the former one. Both of the interambulacra of the ventral surface may also be divided into a posterior rather convex portion and an anterior shorter, narrower one, which makes an acute angle with the former. The neck-like part, measuring from 8 to 10 mm., is several times narrower than the rest of the body, and extends considerably below the ventral surface. On account of that neck-portion being bent downwards and backwards, the anterior and posterior contours of the body form almost a semicircle. The posterior third of the ventral surface is extremely convex, and approaches the upper surface. If the neck-like part of the animal, when living, is really as strongly bent downwards as I have thought, the mouth, being situated at its extremity, must also be directed downwards. If, however, the bend of the neck-like part depends only upon an accidental contraction, so that the neck in its normal condition is extended forwards, then the mouth will attain a terminal position in the anteriorly narrowing extremity of the body. The tentacles (Pl. XLIV. fig. 10) are cylindrical, equally large, measuring from 5 to 7 mm. in length; their terminal part is not remarkably enlarged, and is provided with retractile processes round the edge. The pedicels are sixteen in number, but are only found on the posterior third of the ventral surface, where that is more obviously convex; the foremost pairs are cylindrical in form, and are of almost the same size as the tentacles; they thus exceed the posterior ones greatly in size, and are evidently situated nearer the medio-ventral line. The transverse dorsal appendage does not reach a greater height; its breadth on the contrary is considerable, approaching that of the body. It seems to be produced by four processes, disposed in a transverse row, which are webbed together by an extension of the skin, leaving only their tops free; the two middle processes are considerably larger than the others. Behind that lobe the dorsal surface carries two pairs of extremely minute, almost invisible, processes. The glassy body-wall is transparent and very hard and brittle, by reason of which the pedicels and processes fall off on being slightly touched. The calcareous deposits (Pl. XXXIV. fig. 17) are very numerous and close-set; their four arms, attaining the length of about 0·16 mm. or sometimes more, and having the aspect of being minutely spinose, are sometimes almost straight and directed towards the inside of the body, sometimes on the contrary extremely arcuated, especially at the ends. The processes are straight, finely spinose, and very long, their number varying from two to four; now and then only a single process is to be observed. It seems as if a small pyramidal papilla encloses each deposit. The oral disk contains deposits (Pl. XXXIV. fig. 18) of more or less irregular shape, their arms being almost straight or slightly curved; besides these are found some more or less straight, long spicula, which are either simple or irregularly branched. The ends of the tentacles contain unbranched spicula, and irregular three- or four-armed bodies with or without processes. The ends of the pedicels are provided with only a few unbranched spicula.

The five separated pieces of the calcareous ring bear a great resemblance to those of

Elpidia willemoësi, but their number of rods amounts only to sixteen, eight towards each opposite side. Two small ventral polian vesicles are found, they are of a sack-shaped form, and measure about 5 mm. in length. The madreporic canal, which seems to be destitute of deposits, pierces the dorsal perisoma and opens externally; that part of it which penetrates the body-wall is extremely fine. It is possible that traces of calcareous deposits may be found where the canal enters the integument, though I have not been able to detect them. In the individuals, examined by me, the alimentary canal forms a small convolution posteriorly, and it does not seem impossible that, when the body is extended to its full length, this may vanish so that the digestive tract may have an almost straight antero-posterior course. The cloaca is inconsiderable. All along both of the lateral nerve-cords are to be observed a number of auditory vesicles, containing a varying number of otoliths. The reproductive organ consists of two minute, thick fascicles of small cæca of the usual shape; the common efferent duct divides, when piercing the body-wall, into two narrow canals, which diverging towards each opposite side within the perisoma, reach the dorsal ambulacra, where they communicate with the exterior, each by a pore.

Peniagone affinis, n. sp. (Pl. VIII. figs. 4, 5).

Body elongated, of almost equal breadth throughout, three or four times as long as broad, depressed posteriorly. Mouth anterior, ventral. Anus posterior, subdorsal. Tentacles of almost equal size; two ventral ones a little smaller than the others; their discoidal, terminal part with small, retractile processes. Pedicels about eleven all along each side of the ventral surface. The dorsal surface with a broad, not very high, flat, transverse lobe anteriorly with four projections on its upper margin, the middle ones being considerably larger; behind that lobe are two very small processes on each ambulacrum. Integument rather thin and rough, with numerous crowded calcareous deposits, composed of four more or less arcuated, slightly spinose, arms, and one to four straight spinose processes, directed outwards; the length of the arms and processes extremely variable.

Colour in alcohol, light grey, glassy. Length, about 100 mm. Breadth, about 27 mm.

Habitat.—Station 147. December 30, 1873. Lat. 46° 16′ S., long. 48° 27′ E. Depth, 1600 fathoms; bottom temperature, 0·8° C.; globigerina ooze. Numerous specimens.

In spite of the great number of specimens which has been dredged from the abovementioned locality, only a few are in a tolerably uninjured state. The size is most variable; the largest individual attains the above indicated dimensions, while the smallest has a length of only 20 to 25 mm. and a breadth of about 7 mm. The body is almost equally broad throughout or slightly widened posteriorly, its anterior and posterior ends being evenly rounded. The height decreases gradually backwards, consequently the posterior extremity of the body has a rather flat aspect. The ventral surface is flat or slightly convex, the dorsal, on the contrary, is extremely convex, especially anteriorly. The ends of the tentacles are a little dilated, and are provided with processes of which those round the edge appear to be largest. The pedicels are arranged all along each side of the ventral surface, the first pair arising a little behind the tentacles. The first five pairs are separated from each other by certain distances and disposed along the anterior four-fifths of the body; the distance between the different pairs decreases gradually backwards. The posterior six pairs of pedicels are, on the contrary, closely crowded side by side around the posterior fifth part of the ventral surface, several of the middle ones being very small; they are webbed together by an extension of the skin, leaving only their ends free. The dorsal appendages are exactly like those of the preceding species. The broad, transverse and almost flat lobe, situated about 10 mm. behind the tentacles, reaches an unimportant height, only about 10 mm., the projections included; its two middle projections present a conical form and attain a considerable size in comparison with the other two, which are almost imperceptible. Immediately behind this lobe two very small papilla-like eminences are to be observed, one on each ambulacrum, and behind those arises another pair; sometimes both of the pairs seem to be wanting. The perisoma is glassy, thin, and transparent, that of the ventral surface possessing a higher degree of pliability and less roughness than that of the dorsal, which to the naked eye appears to be closely covered with minute spines. There exists a remarkable difference between the calcareous deposits of the upper and under surfaces of the body; those in the dorsal perisoma (Pl. XXXIV. fig. 13), are very closely crowded, and consist of four strongly arcuated and finely spinose arms, directed inwards and measuring about 0·28 mm. in length or more, and of one, two, or three straight, slightly spinose processes, which being directed outwards, cause the great roughness of the integument. The arms either run out from a common central point or from the ends of a more or less elongated, rod-like central part. These calcareous deposits bear the strongest resemblance to those of *Peniagone vitrea*. The deposits of the ventral perisoma (Pl. XXXIV. fig. 12) are slightly smaller and more thinly scattered, and resemble the former ones, but differ by having their arms not so obviously curved and only measuring about 0·14 mm. in length or less, each arm carrying close to the elongated central part a short spinose process. The deposits of the oral disk resemble those of the preceding species. The tentacles contain a number of larger or smaller, often strongly arcuated, spicula, with the ends more or less spinose, and among those are to be found three- or four-armed irregular bodies. The ends of the pedicels are provided with a smaller number of arcuated, unbranched spicula, mingled with some four-armed bodies without processes. The five pieces of the calcareous ring are separated from each other as is the case in the preceding species; it is possible that they might meet each other, when the surrounding tissues are in the state of contraction. Each piece is composed of about twenty-four (?) rods, twelve radiating towards each opposite side. Only a single polian vesicle is present. The madreporic canal opens externally by a pore, near the orifice of the reproductive organ. A great number of auditory vesicles is found along both of the lateral nerve-cords of the ventral surface; the number of otoliths varies from one to a multitude. The digestive tract makes a small convolution. The cloaca is not very important. The reproductive organ consists of two fascicles, each composed of a comparatively wide tube, into which opens a number of bundles of very small cæca; the organ of the largest individual reaches the length of 15 to 20 mm.

When comparing *Peniagone vitrea* and the above described species, one finds several striking points of resemblance; the position and aspect of the appendages of the dorsal surface, as well as the roughness of the integument and the shape of the calcareous bodies, have a great deal of similarity. They differ, on the contrary, much from each other in several extremely obvious characters. First we have to observe the form of the body, which is more depressed in *Peniagone affinis*, and wants the narrow, downwardly directed neck-like part; besides, the pedicels of this species are arranged all along the sides of the ventral surface, not only around its posterior part, and the five or six posterior pairs are webbed together, consequently only their ends are free, while all the pedicels of *Peniagone vitrea* are free.

Tabular View of the Species of the Genus *Peniagone*.

I. Calcareous deposits: four-armed bodies with one to four processes directed outwards.
A. Body anteriorly with a narrow neck-like part directed downwards. Pedicels sixteen, disposed round the posterior third of the ventral surface, . . *Peniagone vitrea.*
B. Body destitute of a narrow neck-like part.
a. Pedicels twenty two, eleven all along each side of the ventral surface, . *Peniagone affinis.*
b. Pedicels only round the posterior half or two-thirds of the ventral surface.
× Body posteriorly almost flat, and with an incision in its middle. Pedicels seventeen, ... *Peniagone challengeri.*
× × Body posteriorly not flattened, and without incision.
1. Dorsal appendage in direction of the medio-dorsal line. Pedicels sixteen or eighteen, ... *Peniagone horrifer.*
2. Dorsal appendage in a transverse position, not very broad and without visible processes. Pedicels about ten, . . *Peniagone atrox.*
3. Dorsal appendage in a transverse position, broad and with four small processes. Pedicels about ten, . . . *Peniagone lugubris.*
4. Dorsal appendage in a transverse position, broad and with four long processes. Pedicels about sixteen, . . *Peniagone wyvillii.*

II. Calcareous deposits: three-armed bodies; branched or unbranched spicula; and small C-shaped ones, ... *Peniagone naresi.*

Scotoanassa,[1] n. gen.

Body very depressed, almost flat, with an extension of the body-wall constituting a broad rather flat brim round its anterior and posterior ends. Tentacles ten. The dorsal surface with processes only on the margin of the anterior brim. The ventral surface with pedicels only round the margin of the posterior brim. Integument with calcareous deposits, composed of four arms and four outwardly directed processes.

Scotoanassa diaphana, n. sp. (Pl. IX. figs. 3–5).

Body about thrice as long as broad. Mouth ventral, behind the anterior brim. Anus dorsal, immediately in front of the posterior brim. Tentacles of almost equal size; their terminal part with two rather long, digitiform processes and with a number of small, branched, retractile projections. Processes of the dorsal surface very small, four on the margin of the anterior brim. Pedicels of the ventral surface ten, round the margin of the posterior brim; the two middle ones very small. Integument thin and transparent; calcareous deposits slightly scattered, composed of four spinose, slightly curved arms, diverging two from each end of a long rod-like central part; each arm with a spinose process directed outwards.

Colour in alcohol, white and glassy. Length, about 50 to 55 mm. Breadth, about 18 to 20 mm.

Habitat.—Station 160. March 13, 1874. Lat. 42° 42′ S., long. 134° 10′ E. Depth, 2600 fathoms; bottom temperature, 0·2 C.; red clay. One specimen.

The body is distinguished by its slight height, the dorsal and ventral surfaces possessing about the same degree of convexity. Four elongated conical canals pass through the brim round the anterior part of the body, each running out into a corresponding almost imperceptible process on the margin of the brim. By closer examination it is easy to discover that the two left hand canals communicate with the left dorsal ambulacrum and the two others with the right. The brim has the appearance of being constituted by four dorsal processes, which are intimately united with each other by an extension of the connective tissue layer of the body-wall, leaving only their tops free. The brim, which thus belongs to the dorsal surface, reaches its greatest breadth, about 8 mm., anteriorly, and decreases regularly towards each side. The posterior brim, which is thin, flat, and almost equally broad, about 7 mm., belongs for a similar reason to the ventral surface, its pedicels, which project around its margin, being in connection with long canals which penetrate the brim and communicate with the ventral lateral ambulacra. The two middle pedicels are quite unimportant and almost imperceptible. On account of this arrangement of the two brims the mouth has a more distinct ventral position, and the anus is more perfectly dorsal than is usually the case. The tentacles (Pl. XLIV. fig. 9) are rather large, and end in two long digitiform processes; these as well as the rest of the terminal part of the tentacles are provided with a number of small, branched, retractile projections devoid of deposits. The calcareous deposits (Pl. XXXV. fig. 18) do not lie very close together, and vary generally in size, the largest ones having their arms measuring about 0·16 mm. and their elongated rod-like central part of about the same length. The ends of the tentacles as well as of the pedicels contain spicula.

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[1] Σκότος = darkness.

Only a single polian vesicle is present, attaining the length of about 4 to 5 mm. From want of material for examination, I am somewhat undecided with regard to the madreporic canal, whether it communicates with the exterior or not. The alimentary canal has no cloaca. The reproductive organ, consisting of a very small fascicle of cæca, attains a length of about 7 or 10 mm.; its duct opens a little above the crown of the tentacles where the brim projects.

Enypniastes,[1] n. gen.

Body very depressed, with an extension of the body-wall round its anterior extremity, constituting a very large, broad, rather flat brim. Tentacles twenty (?). The dorsal surface with small projections round the margin of the brim and with some other very small processes on its ambulacra. Pedicels along the sides (?) and round the posterior extremity of the body.

Enypniastes eximia, n. sp. (Pl. VIII. figs. 6, 7).

Body about twice as long as broad. Mouth ventral, behind the very broad brim. Anus dorsal. The dorsal surface with numerous small processes round the margin of the brim, and with some other very small ones, disposed in pairs on the ambulacra.

Colour in alcohol, light grey. Tentacles and processes brown, inclining to violet. Length, about 72 mm. Breadth, about 32 mm.

Habitat.—Station 168. July 8, 1874. Lat. 40° 28′ S., long. 177° 43′ E. Depth, 1100 fathoms; bottom temperature, 2·0° C.; grey ooze. Four very incomplete specimens.

The four specimens brought home are unfortunately so lacerated and in such a state of maceration as to render any closer examination impossible. It is not possible to form any correct idea of these very interesting forms, on account of which I have not been able to give any complete drawings but only some simple outline figures, and I even feel very considerable uncertainty as to the correctness of those. The dorsal surface is slightly convex and the ventral one almost flat, the body thus becoming very depressed. The animal attains its greatest breadth a little in front of the mouth. With regard to the broad brim, formed anteriorly by the body-wall and pierced by a number of wide close-lying canals, the mouth has the aspect of being situated unusually far, about 30 mm., from the anterior extremity of the body. At first sight one is almost tempted to think that the mouth is situated near the middle of the ventral surface, but on making a closer examination of that part of the body which lies in front of the mouth, one becomes convinced that the whole of this part is constituted by an extension of the dorsal perisoma forming the above-mentioned brim, and that, consequently, the mouth is really placed on the anterior part of the ventral surface. The peritoneal cavity is thus not prolonged much in front of the mouth. The large, wide canals, penetrating the brim side by side, are in connection with the dorsal ambulacra; some of them on each side communicate possibly with the ventral lateral ambulacra, but I am not certain as to this. The canals taper towards their cæcal ends, and the rather large spaces between them are occupied by the connective tissue of the brim. Each of the canals enters one of the more or less considerable processes which are to be observed round the margin of the brim. Almost at the middle of the dorsal surface two pairs of small papilla-like projections can be distinguished; possibly there may have been several others. The tentacles are torn off except in one individual, where I found them to amount to twenty; they seem to be of unequal size; on account of their macerated condition it is not possible to give a description of their true aspect. As the pedicels are mostly torn off their number is unknown. I feel certain that they are present on the posterior end of the body, but must leave it undecided whether they are also to be found along the sides of the ventral surface, though I have thought I could detect some traces of them there. The integument being very flexible is in an extreme degree of dissolution, so that no calcareous bodies can be distinguished.

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[1] 'Ενυϖνιάστης = dreamer.

Achlyonice, Théel.

Achlyonice, Théel, Preliminary Report on the Holothuridæ of H.M.S. Challenger, p. 13.

Body oval or ovate, about twice as long as broad. Tentacles eleven or twelve. The dorsal surface with some processes anteriorly. The ventral surface with pedicels all round its sides. Integument with calcareous deposits composed of three-armed bodies, sometimes along with unbranched spicula and small wheels.

Achlyonice paradoxa, Théel (Pl. V. figs. 1–2).

Achlyonice ecalcarea, Théel, Preliminary Report on the Holothuridæ, p. 13.

Body ovate, widening behind, about twice as long as broad. Mouth anterior, subventral. Anus posterior, dorsal. Tentacles twelve, of equal size; their terminal part very large, discoidal, with small retractile processes. Pedicels twenty-seven, disposed along the sides and round the posterior part of the ventral surface. The dorsal surface with about six very soft and flexible processes disposed in an almost transverse row on its anterior part. Integument very thick, soft, spongy, and apparently porous; calcareous deposits composed of three more or less spinose arms, each arm with a process near the common central point.

Colour in alcohol light grey, inclining to green. Length, about 100 mm. Breadth, about 50 mm.

Habitat.—Station 241. June 23, 1875. Lat. 35° 41′ N., long. 157° 42′ E. Depth, 2300 fathoms; bottom temperature, 1·1° C.; red clay. Two specimens.

When preparing the Preliminary Report on the Holothuridæ of H.M.S. Challenger, I had not an opportunity of making a detailed examination of the perisoma of this species, and as it was quite impossible to detect any traces of calcareous deposits either by a microscopic examination of small pieces of the integument or by treating them with a solution of potass, I took for granted that there were none. By using such colouring matters as hæmatoxylin, however, I have been persuaded that I made a mistake in stating that the perisoma was destitute of deposits. This reagent brings out with such distinctness the extremely thin sheaths or membranes which surround the calcareous deposits, that one gets a fairly true idea of their forms, though the calcareous matter has been dissolved for a considerable time. On account of this I have thought it necessary to change the name of the species so as to avoid the chance of misapprehension.

The dorsal surface is extremely convex, the ventral, on the contrary, is almost flat or slightly concave. An obvious edge marks the transition between these surfaces. The body is especially broad posteriorly and rounded in the form of a semicircle, and decreases anteriorly towards the crown of tentacles where it is almost truncated. The mouth, the surrounding oral disk, as well as the tentacles, are almost terminal, being slightly inclined towards the ventral surface. The anus is of considerable size, and is situated on the dorsal surface, about 17 mm. from the sharp edge which separates the ventral and dorsal surfaces posteriorly. The left side of the extremely convex dorsal surface is divided into large rhomboidal or quadrangular prominent areas, separated from each other by furrows; these have been caused by abnormal contraction, though it may appear very peculiar that both of the specimens should possess them. The tentacles seem to be of almost equal size, some of the ventral or dorsal ones being slightly smaller. Their large, discoidal ends, projecting beyond the supporting stems, are provided with a number of very small, retractile processes, especially round their margin. The ventral surface bears thirteen pedicels all along its sides and an odd one posteriorly, in the middle, the first pair projecting near the tentacles. Most of them are retracted, but a few which are in a state of extension indicate that they are rather short, with their terminal part large, flat, and slightly convex. About 35 or 40 mm. behind the crown of tentacles the dorsal surface supports about six conical processes, which are arranged in an almost transverse row, and attain the length of about

5 to 6 mm.; in their fully extended state they appear to have a greater length. Those processess communicate with both of the dorsal ambulacra, three with each. On examining the inside of the body-wall one discovers three pairs of ambulacral cavities (Pl. XLI. fig. 5) disposed one a little in front of the other; the first pair of these cavities is in connection with the two middle processes, the posterior pair with both of the outermost processes, and the middle ones with each of the others. In one individual I observed in front of those processes eight papillæ far separated from each other, and so small that they were scarcely distinguishable to the naked eye; their nature will be discussed further on. The perisoma, being particularly thick, soft, and spongy, seems to be in a very macerated condition; on its surface it is easy to distinguish by the naked eye a number of small holes (Pl. XXXIX. fig. 3) which give the integument a porous aspect; they enter small cæcal cavities, the function of which I have not been able to understand. As stated above the calcareous substances are quite dissolved, but the membranes which have surrounded the deposits are, on the contrary, easy to discover; by staining them in hæmatoxylin, one is able to form a correct idea of their former aspect (Pl. XXXIX. fig. 7). From a common centre three straight, slightly spinose arms, about 0·2 mm. long, run out, forming angles of equal size with each other; each arm gives off, close to the centre, a process directed obliquely outwards. Whether some deposits of another shape occur or not, it is difficult to decide, though I have thought I could detect traces of curved, spinose and unbranched spicula. It is also impossible to tell either the shape of the calcareous ring, or whether the madreporic canal has deposits or not.

The polian vesicle measures about 30 or 35 mm. in length. Though I have not been able to discover any pore of the madreporic canal I have succeeded in following the canal itself in its passage through the thick perisoma, and am thus persuaded that it really communicates with the exterior. The narrow alimentary canal terminates posteriorly in a very large and wide cloaca, which towards the left side has a remarkably large cæcal prolongation which ascends towards the middle of the peritoneal cavity; the breadth of the prolongation is about half that of the body or sometimes more. The reproductive organ is elongated and almost as long as the body itself, it is constituted by a single fascicle of numerous small cæca. The common efferent duct divides, where it penetrates the perisoma, into a number of larger and smaller narrow canals, which pass through the integument and end in the tops of the above-mentioned very small papilla-like dorsal processes. The organ is situated on the left side of the peritoneal cavity.

Achlyonice lactea, n. sp.

Body oval, about twice as long as broad. Mouth anterior, subventral. Anus posterior, dorsal. Tentacles eleven or twelve, of nearly equal size; their terminal part rather large, discoidal, with retractile processes. Pedicels about twenty-six, thirteen along each side of the ventral surface. The anterior part of the dorsal surface bearing some small processes. Integument thin, soft, and transparent, with three sorts of calcareous deposits: numerous three-armed, spinose bodies, each arm with two opposite, very spinose processes; a few spinose unbranched spicula, and small scattered wheels, with twelve spokes.

Colour in alcohol, white. Length, about 40 mm. Breadth, about 20 to 25 mm.

Habitat.—Station 147. December 30, 1873. Lat. 46° 16′ S., long. 48° 27′ E. Depth, 1600 fathoms; bottom temperature, 0·8° C., globigerina ooze. Four specimens.

All the four specimens being very contracted, it is difficult to determine their size or true shape, which however seem to agree with those usual in the genus *Elpidia*. The ventral surface is more or less flat, the dorsal, on the contrary, is extremely convex. The body is nearly evenly rounded towards its extremities. The number of tentacles varies from eleven to twelve, and their size does not seem to be constantly equal, two of the dorsal ones being rather rudimentary in one individual. Their terminal part bears processes, those round the edge being largest. Two of the animals carry twenty-six closely crowded pedicels, and probably the number on the other two is the same, though I have not been able to determine it. From the state of contraction of the body, it is impossible to form any correct idea of the dorsal processes; it seems, however, that some small ones project anteriorly, close to the tentacles. The three-armed deposits (Pl. XXXII. figs. 21–23) vary greatly in size, the arms of the largest ones measuring about 0·22 mm. in length; each arm carries at some distance from the common centre two very spinose processes. The deposits of the ventral surface are smaller and more scattered, have a more irregular shape, and give off considerably smaller processes; besides those, a few spinose unbranched spicula are to be found. The wheels, which are scattered over the dorsal as well as the ventral surface, measure about 0·06 mm .in diameter, and are provided with twelve spokes; between each of those the felly gives off a rounded process or lobe, directed obliquely outwards. The nave is large, and sends out from its middle a small irregular crown, consisting of four slightly curved rods united with each other. The pedicels contain some straight and curved, spinose or smooth, spicula of greater or smaller size. The tentacles have also some spicula, which seem to bear one or several branches. The calcareous ring seems to resemble that of *Parelpidia elongata;* each of its five pieces gives off about twenty-four diverging rods, their ends being flattened and dilated. Only a single polian vesicle is present, measuring about 8 mm. in length.

Family II. DEIMATIDÆ.

Body usually rather long, cylindrical or fusiform, seldom shorter and of an elliptical form. Tentacles fifteen or twenty. Mouth almost terminal, though more or less distinctly turned towards the ventral surface. The lateral ambulacra of the ventral surface bearing very long and wide, cylindrical or conical, slightly retractile pedicels, disposed either in a single or a double row along each side of that surface, and sometimes provided with another series of extremely elongated, conical, non-retractile processes placed externally and above the pedicels. The odd ambulacrum generally naked, seldom with a few rudimentary pedicels or with a double row of rather large ones. The dorsal surface with very long, elongated, conical, mostly non-retractile processes, disposed in one or more rows all along each of its ambulacra. Calcareous deposits: perforated plates, spicula, wheels, cruciform and dichotomously branched bodies. Calcareous ring composed of a rather fragile and imperfect net-work; no distinct radial or interradial pieces.

The genera which are included under the head of this family seem in general to be well defined. *Deima* differs from the others not only in having its calcareous skeleton more fully developed and in the minute size of its tentacles and their capability of being drawn within the body, but by the presence of a highly characteristic system of canals, which is in communication with the water-vascular system, and is more fully described in the anatomical part of this report. *Oneirophanta* bears the nearest resemblance to this genus from the shape of its calcareous bodies, but it differs from it not only in the above noted peculiarities, but also in the number and position of its processes and their degree of flexibility, and above all by the pedicels of its ventral lateral ambulacra being arranged in a double row.

As *Orphnurgus* is distinguished by its characteristic calcareous bodies, it keeps its place as an independent genus. *Lætmogone*, *Ilyodæmon*, and *Pannychia* constitute a group by themselves, which is characterised by the perisoma containing wheels of diverse dimensions. *Lætmogone* carries only a single row of processes along each of the dorsal ambulacra, and a single row of pedicels along each side of the ventral surface; while the two other genera are provided with numerous dorsal processes which are either arranged in several more or less distinct rows along each ambulacrum or are scattered irregularly over the lateral interambulacra. Like *Lætmogone*, *Ilyodæmon* possesses fifteen tentacles, and has its odd ambulacrum naked, but its lateral pedicels are disposed in double rows. *Pannychia*, on the other hand, is provided with twenty tentacles, and carries a single row of pedicels along each side and a double row of smaller ones along the odd ambulacrum. There can be no doubt that these three genera are closely allied, and this affinity is most striking between *Ilyodæmon* and *Pannychia*. As three species of *Lætmogone* have been discovered which have all the above-mentioned generic characters in common, I feel convinced that this genus is well defined; with regard to the two others I take it for granted that the difference in the number of tentacles, and above all in the arrangement of the pedicels, will justify their being placed as different genera.

Tabular View of the Genera of the Family Deimatidæ.

- I. Integument mostly rather hard, strengthened by numerous perforated calcareous plates, often crowded and forming a skeleton; tentacles twenty.
  - A. Tentacles small, retractile. Pedicels of the ventral lateral ambulacra in a single row, ... Gen. I. *Deima.*
  - B. Tentacles large, not retractile. Pedicels of the ventral lateral ambulacra in a double row, ... Gen. II. *Oneirophanta.*
- II. Integument pliable, strengthened by scattered spinose spicula; tentacles twenty, . Gen. III. *Orphnurgus.*
- III. Integument very pliable, containing wheels along with spicula, cruciform bodies, or dichotomously branched deposits.
  - A. Tentacles twenty; odd ambulacrum with a double row of pedicels, . Gen. IV. *Pannychia.*
  - B. Tentacles fifteen; odd ambulacrum naked.
    - *a.* Dorsal processes very long, disposed in a single row along each ambulacrum, ... Gen. V. *Lœtmogone.*
    - *b.* Dorsal processes shorter, disposed in several rows along each ambulacrum, ... Gen. VI. *Ilyodœmon.*

Oneirophanta, Théel.

Oneirophanta, Théel, Preliminary Report on the Holothuridæ, p. 6.

Tentacles twenty, large, and not capable of being retracted within the mouth. The lateral ambulacra of the ventral surface with large pedicels disposed in a double row all along each side of that surface, and with another series of very elongated, conical, more or less flexible, non-retractile processes, placed externally and above the pedicels all along each side of the body. The odd ambulacrum with a few more or less rudimentary pedicels. The dorsal surface with processes, resembling those of the ventral lateral ambulacra, disposed in a single row all along each of its ambulacra. Integument with more or less crowded, irregularly rounded, perforated plates, sometimes forming a rather hard skeleton.

Oneirophanta mutabilis, Théel (Pl. XXI. fig. 2; and Pl. XXII.).

Oneirophanta mutabilis, Théel, Preliminary Report on the Holothuridæ, pp. 6, 7.

Body elongated, of almost equal breadth throughout, more than twice as long as broad. Mouth anterior, subventral. Anus posterior, ventral. Tentacles of equal or unequal size; their terminal part with six to eight small unbranched processes. Pedicels varying greatly in number from about fifty-four in all—twenty-eight along the left side and twenty-six along the right—to only eleven along each side or even less. The odd ambulacrum with two to nine small pedicels. Processes of each of the lateral ambulacra of the ventral surface varying in number from about seventeen to seven or less. Processes of each of the dorsal ambulacra varying from seventeen or nineteen to seven or less. The length of the processes varying greatly, some being almost rudimentary, others as long as the breadth of the body or more. Integument thin, but rather hard and brittle, with larger and smaller, irregularly rounded, perforated plates, either scattered or crowded, and then covering one another with their edges; each plate bearing near its centre one or more small spines or processes.

Colour in alcohol, light grey, glassy or violet. Length of the largest specimen, 204 mm. Breadth, 86 mm.

Habitat.—Station 146. December 29, 1873. Lat. 46° 46′ S., long. 45° 31′ E. Depth, 1375 fathoms; bottom temperature, 1·5° C.; globigerina ooze. Station 157. March 3, 1874. Lat. 53° 55′ S., long. 108° 35′ E. Depth, 1950 fathoms; diatom ooze. Station 160. March 13, 1874. Lat. 42° 42′ S., long. 134° 10′ E. Depth, 2600 fathoms; bottom temperature, 0·2° C.; red clay. Station 241. June 23, 1875. Lat. 35° 41′ N., long. 157° 42′ E. Depth, 2300 fathoms; bottom temperature, 1·1° C.; red clay. Station 244. June 28, 1875. Lat. 35° 22′ N., long. 169° 53′ E. Depth, 2900 fathoms; bottom temperature, 1·2° C.; red clay. Station 281. October 6, 1875. Lat. 22° 21′ S., long. 150° 17′ W. Depth, 2385 fathoms; bottom temperature, 0·8° C.; red clay. Station 299. December 14, 1875. Lat. 33° 31′ S., long. 74° 43′ W. Depth, 2160 fathoms; bottom temperature, 1·1° C.; grey mud. Station 325. March 2, 1876. Lat. 36° 44′ S., long. 46° 16′ W. Depth, 2650 fathoms; bottom temperature, 0·4° C., grey mud.

Having obtained a smaller or greater number of individuals from each of the above localities, a great abundance of material has been at my disposal. As the name indicates, this species is represented in many varying forms, individuals not only from different localities but even from the same station presenting considerable diversities. If I had only had the opportunity of examining a few forms I should doubtless have made the mistake of referring them to several different species, but on account of the abundance of material, I have been able to observe a series of gradations filling up the intervals between the extreme forms. All the specimens evidently belong to the same species, though they may possess one or more differences which at first may appear to be of such importance that they could not be classed under the head of variations. The size varies extremely, the smallest individuals reaching only a length of 35 mm. and a breadth of 10 mm., while the largest ones attain gigantic dimensions. The difference in the general appearance of the body depends upon the number of pedicels and processes, which in its turn would seem to depend upon the size of the animal, so that the larger individuals would be provided with a greater number than the smaller ones. However, this is not always the case. The largest specimen, for instance, dredged at Station 146, and reaching a length of about 204 mm., has only fifty-six processes, while another individual from Station 241, having only a length of 170 mm., possesses about seventy; another animal dredged at Station 160, about 46 mm. long, carries only nineteen pedicels and nineteen processes, while a considerably smaller specimen, obtained at Station 146 and measuring about 35 mm. in length, gives off about twenty-nine pedicels and thirty-five processes. These statements prove that the number of processes and pedicels is pretty much independent of the size of the animal. The ventral surface is flat or slightly concave, while the dorsal, on the contrary, is extremely convex. Both extremities of the body are evenly rounded. The mouth and anus are ventral, the former having a more terminal position. The colour varies considerably, most of the individuals having a light grey or glassy colour, while those found at Station 157 are of a darker or lighter violet. Before continuing the description, it seems proper to give the following table, exhibiting in what degree variation occurs with regard to the pedicels and processes:—

Station.	Length of the Body.[1]	Breadth of the Body.	Pedicels distinctly disposed in two rows along each side of the Ventral Surface.				Pedicels indistinctly disposed in two rows along each side of the Ventral Surface.		Pedicels of the odd Ambulacrum.	Processes of the Lateral Ambulacra of the Ventral Surface.		Processes of the Dorsal Ambulacra.		Tentacles.	Colour.
			Left Side.		Right Side.										
			Outer Row.	Inner Row.	Outer Row.	Inner Row.	Left Side.	Right Side.		Left Side.	Right Side.	Left Side.	Right Side.		
244	137	48	11	10	12	10	...	...	6	9	11	13	14	of equal size.	light grey.
244	104	37	...	...	...	...	11	12	4	10	10	12	10	of unequal size.	glassy.
244	92	44	9	5	8	6	...	...	4	10	9	11	10	of unequal size.	glassy.
244	78	31	...	...	...	...	13	12	3	8	7	9	10	of unequal size.	glassy.
244	83	32	...	...	...	...	12	11	3	9	8	10	9	of unequal size.	glassy.
244	135	37	16	11	15	11	...	...	9	10	9	12	13	of equal size.	yellowish-white.
244	130	50	...	...	...	...	11	12	3	11	11	11	12	of unequal size.	glassy.
325	102	34	...	...	...	...	14	13	3	7	6	9	9	of equal size.	glassy.
325	109	36	10	4	10	4	...	...	3	9	9	5	7	of equal size.	glassy.
325	109	36	...	...	...	...	11	12	4	12	11	8	10	of equal size.	glassy.
325	106	40	...	...	...	...	15	14	3	10	11	12	11	of equal size.	white, glassy.
325	120	36	...	...	...	...	14	14	4	7	7	7	7.	of equal size.	white, glassy.
325	120	51	...	...	...	...	14	14	4	11	10	10	9	of equal size.	white.
325	122	44	...	...	...	...	13	15	4	11	12	11	12	of equal size.	yellowish-white
160	123	50	...	...	...	...	14	13	3	11	11	5	6	of equal size.	white.
160	120	38	...	...	...	...	11	11	3	12	12	7	8	of equal size.	white.
160	103	34	...	...	...	...	14	14	4	14	14	8	7	of equal size.	yellowish-white
160	120	42	...	...	...	...	12	13	3	11	11	10	8	of equal size.	white.
160	133	40	...	...	...	...	11	11	4	12	12	7	7	of equal size.	white.
160	83	31	...	...	...	...	10	10	4	11	10	8	9	of equal size.	white, glassy.
160	46	15	...	...	...	...	8	8	3	5	6	4	4	of equal size.	glassy.
241	170	60	13	8	11	9	...	...	7	17	17	17	19	of equal size.	glassy.
146	204	82	13	10	13	10	...	...	4	16	15	13	12	of equal size.	white.
146	53	20	10	8	11	6	...	...	6	8	9	9	9	of equal size.	glassy.
146	35	10	...	...	...	...	14	13	2	8	9	9	9	of unequal size.	glassy.
299	134	41	11	10	10	9	...	...	2	6	5	7	7	of equal size.	whitish.
299	126	43	10	7	10	6	...	...	2	10	11	10	11	of equal size.	whitish.
281	90	34	...	...	...	...	15	13	3	11	11	9	10	of unequal size.	glassy.
157	180	58	14	14	14	12	...	...	2	12	12	8	8	of equal size.	dark violet.
157	135	41	...	...	...	...	22	20	4	7	7	4	4	of equal size.	violet.
157	83	25	11	11	11	11	...	...	4	7	7	4	4	of unequal size.	light violet.
157	49	15	10	8	10	8	...	...	2	7	7	9	9	of unequal size.	light violet.

[1] All measurements are given in millimetres.

The tentacles are generally equally large, though not rarely individuals occur in which they are unequal, one or several being considerably smaller. It is necessary to observe, that those smaller tentacles, which have often the same shape as the fully developed ones, but which are sometimes much reduced and destitute of processes on their usually somewhat swollen ends, frequently though not always belong to the ventral surface; the smaller individuals bear tentacles generally of unequal size. The normal tentacle is dilated towards its end, which is discoidal or hand-like, and commonly provided with six simple digitiform processes round its margin; sometimes the processes are seven or eight in number, as is the case with the individuals from Stations 157 and 299. The tentacle itself is not capable of being retracted, while its processes on the contrary are retractile.

As is above noted, the number of pedicels varies extremely, as does also their position. In the large typical forms they are disposed in two distinct rows along each side of the ventral surface, while this arrangement in double rows is scarcely discernible in other individuals, the pedicels being arranged in a single but irregular row along each side. The pedicels of the inner row constantly alternate with those of the outer, so that if we could imagine them united by a line, it would run in a zigzag course. The inner pedicels, being always smaller than the outer ones, seem to be developed later, which may be fully proved by the fact that they are generally rudimentary in young animals, while those of the outer row are well developed. The pedicels are supported by numerous calcareous deposits, are non-retractile, and reach a considerable size, those of the largest individuals attaining a length of 16 mm. and measuring in diameter at their base about 6·5 mm. The odd ambulacrum bears some pedicels, commonly three to four, but sometimes nine, which, in most cases are rudimentary, and rarely acquire a more considerable size; they always remain, however, much smaller than the pedicels of the lateral ambulacra; two of them are generally situated side by side immediately in front of the anal aperture. As is shown in the above table, the processes vary greatly in number and dimensions. They are disposed in four single rows, two running along the dorsal ambulacra, and the others placed along the sides of the body a little above the ventral lateral ambulacra with which they are in connection. Thus the dorsal ambulacra as well as the lateral ambulacra of the ventral surface are furnished with processes, the lateral ones proceeding from the lateral interambulacra. At the posterior and especially at the anterior extremity of the body, where the ambulacra approach one another, it is difficult to decide from the position of the processes which of the ambulacra they belong to, the processes being so closely crowded at these places that it is only by means of injection or a close anatomical examination, that certainty can be obtained. The size varies very greatly even in the same animal, some of the processes being rudimentary while others attain a considerable length almost equal to the breadth of the body. They are usually of a very elongated conical form, and are capable of being retracted. In some of the specimens they seem to be rather inflexible, though they mostly possess a high degree of pliability, this is especially the case in the individuals from Station 299. The animals from that station are also distinguished by the enormous length of their processes, which being about 125 mm. are nearly of the same length as the body. The processes, often brittle and easily broken off, have sometimes the tops bipartite. The specimens from Stations 146 and 157 are provided with processes of comparatively small size.

The perisoma is more or less strongly developed, and is sometimes pliable, sometimes very hard, brittle, transparent, and clear like glass. It is strengthened by numerous calcareous deposits which have the form of larger or smaller, more or less distinctly circular plates (Pl. XXXI. fig. 1), and are in some individuals closely crowded and overlap one another, the perisoma becoming thus more solid and brittle than in other specimens, where the plates lie side by side at greater or smaller distances from one another. The position of the calcareous deposits doubtless greatly depends upon the extent to which the perisoma is contracted; they seem usually to be more closely crowded on the dorsal than on the ventral surface, though sometimes the contrary is the case. The plates do not lie closer than to form two layers, of which the exterior one is distinguished by the smallness of its deposits. It is a remarkable fact that while some of the individuals possess two layers of deposits, others have only one. The plates, varying greatly in size, sometimes measuring about 2·2 mm. or more in diameter, are flat, discoidal, slightly convex outwards and perforated by a great number of usually somewhat circular holes, of which those at the middle are of a considerable size, attaining about 0·32 mm. in diameter; the size of the holes diminishes towards the circumference of the plates, and are consequently only visible as small points round the periphery. The convex side of the plates carries one or more small processes or spines situated close to or at some distance from the the centre; those spines are partly simple, partly give off small branches at their top, which running parallel with the plate itself are in connection with similar branches from other spines, thus forming a network upon the original plate. Here and there plates are found without any projections; several of the individuals obtained at Station 157 are remarkable from having all their plates quite smooth and destitute of spines. Besides the fully developed plates I have found a multitude of others in stages of development. The individuals dredged at Station 157 have the plates extremely firmly constructed and with comparatively small holes.

The pedicels contain a great number of calcareous deposits (Pl. XXXI. fig. 3), of almost the same shape as the above-described plates, though usually smaller; towards the ends the deposits become more simple in form, consisting of longer or shorter rather straight spicula or rods, the ends of which are branched or dilated and perforated. Those spicula have a transverse position. The large circular sole-like end of the pedicels has, besides those more important deposits, a greater number of small almost unbranched spicula, but is destitute of any supporting calcareous plate, though sometimes traces of an undeveloped one are distinguishable. The individuals from Station 241, which differ from the others by their very thin body-wall, have the deposits of the pedicels very much scattered and rod-like up to their base, which is not generally the case. The pedicels, as well as the processes and tentacles, are very brittle and easily broken off. The tentacles are provided with a number of larger or smaller, comparatively short and thick spicula, with their ends slightly or not at all branched. The processes also are supported by a great number of smaller, more or less rounded or elongated perforated plates, and besides these by long more or less straight rods (Pl. XXXI. fig. 2), the ends of which are rather dilated, thin, and perforated; these rods, as well as the elongated plates, have not a transverse position, but lie in the direction of the processes, whereby the flexibility is considerably limited. The oral disk is strengthened by plates and by short, straight rods with their ends either unbranched or having short branches. The calcareous ring (Pl. XXXVII. fig. 4) consists of radial and interradial pieces or ossicles, which are extremely friable, and present the structure of a very fine network, and are united with one another by connective tissue. In consequence of their extreme friability, it is rather difficult to isolate them from one another; they break off even on the most careful treatment with solution of potass. The five radial pieces, being of a more solid structure, are however comparatively easily distinguishable; they measure about 3·4 mm. in breadth, and each has a deep furrow for the passage of the nerve-cord, which proceeds from the circumœsophageal nerve to the parietes of the body. The interradial parts of the calcareous ring are more irregular, very thin, and deeply concave anteriorly; it is impossible to determine whether they are simple or compound, but on treating them with solution of potass, I thought I could observe that they were divided each into three pieces. The polian vesicle arises from the left ventral portion of the circular vessel, and is of a cylindrical or extremely elongated conical form; its size varies greatly, and in one individual from Station 244 it reaches the enormous length of 134 mm., thus attaining almost the length of the animal itself. The madreporic canal (Pl. XXXVIII. fig. 11) contains calcareous deposits of varying appearance, partly small perforated plates, partly spicula, which are also to be found in the adjacent mesenteric membrane. The madreporic canal springs from the dorsal part of the circular vessel and, taking a curved course, passes upwards and forwards to the dorsal body-wall, where it terminates in the porous madreporic tubercle (Pl. XXXVIII. fig. 12), which is closely united with the inside of the perisoma in the medio-dorsal line a little behind the crown of tentacles. Through the openings in the madreporic tubercle, the interior of the ambulacral system communicates with the peritoneal cavity. The large ambulacral cavities (Pl. XLI. figs. 1, 2, and 4), which lie within the perisoma and communicate with the pedicels and processes, are very peculiar, and deserve the greatest attention. In the anatomical part of the report they will be described in more detail. Those ambulacral cavities are distinguished by their size, as well as by giving off a number of cæcal prolongations, which run into the connective tissue of the perisoma; those cavities which belong to the pedicels and processes of the ventral lateral ambulacra lie, of course, very close side by side, and mostly overlap one another. In order to get a correct idea of their position and general appearance it is very advantageous to inject into the pedicels and processes.

The digestive tract is throughout the whole of its long course attached to the inside of the dorsal perisoma by a fenestrated continuous mesenteric membrane. The cloaca is of little importance. The reproductive organ (Pl. XLVI. figs. 6 and 7) is made up of two fascicles of unbranched, elongated, cæcal sacks, communicating anteriorly, where they are attached, one fascicle on each side of the dorsal mesentery, with a single efferent duct. In some individuals each fascicle consists of only three to four or usually eight to nine cæca, which in comparison with the length of the body are short; in other specimens they are made up of a great number of very small cæca. Before finishing the description of this species it may not be out of place to point out the differences which distinguish the forms dredged at Station 157 from the others, and which possibly may appear to be of such a nature as to justify their separation as at least a variety. We have then to note the violet colour, which is peculiar to those specimens, the comparatively minute length of the processes, and, finally, the firm construction of the calcareous plates and their want of spines or other projections, this latter peculiarity being however common to several individuals from other stations.

Deima, Théel.

Deima, Théel, Preliminary Report on the Holothuridæ, pp. 4, 5.

Tentacles twenty (?), small and capable of being retracted within the mouth. The lateral ambulacra of the ventral surface with large pedicels, disposed in a single row all along each side of that surface, and with another series of very elongated, conical, rigid, non-retractile processes, placed externally and above the pedicels all along each side of the body and directed straight outwards. The odd ambulacrum naked. The dorsal surface with processes, resembling those of the ventral lateral ambulacra, disposed in a single row all along each of its ambulacra. Integument with crowded, irregularly rounded, perforated plates, forming a rather hard skeleton.

Deima validum, Théel (Pl. XVIII. and Pl. XIX.).

Deima validum, Théel, Preliminary Report on the Holothuridæ, p. 5.

Body of an almost elliptical form, about once and a half as long as its greatest breadth. Mouth anterior, ventral. Anus posterior, ventral. Tentacles very small, perfectly retractile; their terminal part with five to six small retractile processes. Pedicels eleven along each side of the ventral surface; the posterior pair, behind the anus, minute. Processes of the lateral ambulacra of the ventral surface seven, almost inflexible, and nearly as long as the greatest breadth of the body; behind the anus a rudimentary one. Processes of each of the dorsal ambulacra six to eight, resembling the preceding in size and shape. Integument very thick and hard, with two kinds of calcareous deposits: small branched spicula of various shape; and larger and smaller, irregularly rounded, perforated crowded plates, covering one another completely or with their edges alone.

Colour in alcohol, light grey. Length, about 165 mm. Breadth, about 95 mm.

Habitat.—Station 246. July 2, 1875. Lat. 36° 10′ N., long. 178° 0′ E. Depth, 2050 fathoms; bottom temperature, 1·3° C.; grey ooze. Two specimens.

The ventral surface is perfectly flat, while the dorsal one, on the contrary, is extremely convex; the anterior and posterior extremities of the body are almost evenly rounded. The mouth and anus are situated quite on the ventral surface, the latter a little in front of the hindmost pair of pedicels. The bilateral symmetry is particularly strongly marked in this form, especially in regard to the external organs. The pedicels along one side of the ventral surface correspond in number as well as in position and size with those of the other side. The same seems to be the case with the processes, excepting those along the dorsal ambulacra which are slightly variable, though the bilateral symmetry is still traceable even there. The normal number of the dorsal processes seems to be eight along each ambulacrum, though through deformity one or several processes may be wanting; thus one individual possesses six processes along the left ambulacrum and eight along the right, while another specimen has eight along the left ambulacrum and seven along the right. The place where the absent process ought to have been is always plainly indicated by the larger size of the interspace between the processes which lie in front and behind. The pedicels in the middle of the body are larger than the others, about 10 mm. in diameter at the base; their top only is retractile. The processes vary greatly in size, and attain sometimes a length approaching almost the greatest breadth of the body; their form is elongated conical and their base measures about 17 mm. in diameter. The tentacles (Pl. XLIII. fig. 3) of this species as well as those of *Deima fastosum* are very small in comparison with those of the other known forms, and capable of being completely retracted, at the same time the whole crown may be withdrawn, which is not the case in any other forms of the families Deimatidæ and Elpidiidæ. The individuals of the genus *Deima* which I have been able to examine, all have the tentacles drawn into the body, and are thus no longer visible externally. They are quite enclosed in an oral cavity which communicates with the exterior by a small rounded aperture, placed in the centre of a more or less circular disk, round the circumference of which are to be found numerous minute papillæ, the importance of which I have pointed out in the anatomical part of the report. On account of the retracted state of the tentacles it is impossible to determine whether they are disposed in a simple row or in a double crown, though I believe the former to be the case. The end of the tentacles carries five or six processes, of which a couple appear to be larger than the others.

The perisoma is hard, unpliable, and particularly thick, the latter is especially the case with the body-wall along both sides on the transition between the ventral and dorsal surface where the layer of connective tissue is greatly developed. Three different layers of calcareous deposits are distinguishable. The outermost layer consists of scattered, very small, more or less curved, and branched spicula (Pl. XXXI. fig. 8) of various shapes. The intermediate layer is composed of closely placed plates (Pl. XXXI. figs. 4, 5, and 6), which cover one another completely or with their edges alone, and give the perisoma its firmness. These plates are partly large, about 7 mm. in diameter, and of a more circular form, partly smaller arranged round the former and of a more variable shape. Each plate presents the appearance of a flat network with the upper surface convex, its greatest thickness being at its centre; its under surface is perforated by numerous more regularly rounded holes, while the upper one presents an irregular network provided with some small scattered spines. The innermost layer is made up partly of more or less branched spicula and partly of larger net-like bodies (Pl. XXXI. fig. 9) with wide meshes. Besides those deposits I have found some minute bodies in the form of grains, which are sometimes joined together in bands within the connective tissue, but those are probably a chemical product formed during preservation in alcohol. The tentacles contain a minute number of deposits in the form of small scattered spicula. The deposits of the pedicels and processes strongly resemble the above-described plates, though smaller; the ends of the pedicels have no supporting terminal plate, but are instead provided with small generally more or less branched spicula (Pl. XXXI. fig. 7).

From want of material I have not been able to closely examine the calcareous ring, but it appears to resemble in form as well as in structure that of *Deima fastosum;* it is extremely fragile, and becomes separated into small pieces on being treated with solution of potass. The polian vesicle reaches a length of 30 mm. The water-vascular system corresponds with that in *Oneirophanta,* and in regard to its details I refer to the anatomical part of the report. The cloaca is insignificant. The digestive tract is attached to the inside of the dorsal perisoma by a mesenteric membrane. The reproductive organ (Pl. XLVI. fig. 5) consists of two fascicles, one on each side of the mediodorsal mesentery, each fascicle composed of from five to six long, narrow cylindrical tubes, which carry a number of larger or smaller globular cæcal sacks. A great part of the internal organs such as the water-vascular system, the pseudhæmal vessels, the alimentary canal and the genital organs, contain a great abundance of calcareous deposits in their walls, which generally have the form of branched or simple more or less curved spicula, of net-like bodies and of perforated plates. The mesentery also contains numerous small spicula.

Deima fastosum, Théel (Pl. XX. and Pl. XXI. fig. 1).

Deima fastosum, Théel, Preliminary Report on the Holothuridæ, pp. 5, 6.

Body elongated, of almost equal breadth throughout, more than twice as long as broad, largest a little behind its middle. Tentacles very small, perfectly retractile; their terminal part with about eight small retractile processes. Pedicels eleven or thirteen along each side of the ventral surface; the posterior pairs small. Processes of each of the lateral ambulacra of the ventral surface four, inflexible and much longer than half the breadth of the body. Processes of each of the dorsal ambulacra four, resembling the preceding in size and shape. Integument hard and brittle, with crowded, larger and smaller, irregularly rounded, perforated plates, covering one another completely or with their edges only; every plate rising towards its middle into a large, conical knob.

Colour in alcohol, light grey. Length, 130 mm. Breadth, 58 mm.

Habitat.—Station 216. February 16, 1875. Lat. 2° 56′ N., long. 134° 11′ E. Depth, 2000 fathoms; bottom temperature, 0·9° C.; globigerina ooze. Two specimens.

The body is almost perfectly symmetrically bilateral in having the pedicels and processes of the one side exactly corresponding in size as well as in position with those of the other side; the only asymmetry which may be observed concerns the third pair of dorsal processes, the left one of which is situated a little more posteriorly than the right one. Besides, the processes of the dorsal as well as of the ventral lateral ambulacra form not only four longitudinal rows, but also distinct transverse rows. In the above diagnosis I have stated that the lateral ambulacra of the ventral surface give off four pairs of processes, counting the two hindmost processes of the body as belonging to those ambulacra, though to judge from their position they may belong to the dorsal ambulacra, which is the case with the two foremost processes; from want of material I have not been able to make a more detailed examination. If the hindmost processes, contrary to my opinion, should really belong to the dorsum, its ambulacra possess of course five pairs of processes, while the lateral ambulacra of the ventral surface are only supplied with three. The ventral surface is flat or slightly concave, while the dorsal one is extremely convex, the body attaining its greatest width in the posterior half. The mouth and anus are on the ventral surface, and the latter is situated a little in front of the hindmost pedicels. The number of pedicels appears to vary in different individuals, the largest specimens which I have had at my disposal having only eleven pairs, while the other individual which is several times smaller carries about thirteen pairs. Thus, as in *Oneirophanta*, the number of pedicels is not in proportion to the size of the body. The anterior and posterior pairs are small in comparison with the interjacent ones. The pedicels have a conical form, with their base considerably wider than their top, which is capable of being retracted. Those of the processes which are arranged along the sides of the body lie in the same plane with the ventral surface as in *Deima validum*, while the others project from the dorsal surface;

they are of an elongated conical form, and some of them are almost as long as the greatest breadth of the body. The body-wall passes imperceptibly into the processes, consequently it is rather difficult to state their exact size at the base. The processes are straight, brittle, and easily broken off, and appear to possess an extremely slight degree of flexibility. The tentacles (Pl. XLIII. fig. 3), the discoidal ends of which carry about eight minute retractile processes, are, as in *Deima validum*, small and capable of being withdrawn, thus rendering it impossible to discover any traces of them externally. The anterior circular aperture, which opens into the oral cavity in which the tentacles are enclosed, is surrounded in this species also by a circular disk encircled by a single crown of minute papillæ (Pl. XLIII. fig. 2). The integument, which is extremely brittle and hard, is supported by larger or smaller plates (Pl. XXXI. figs. 10, 11), which are crowded together and cover one another entirely or with their edges alone, so as to form a kind of external skeleton of remarkable firmness. Now and then some very large plates measuring up to 5 mm. are found, especially on the dorsal surface, round which are arranged some small plates, which mostly overlap the former ones. The inner surface of each plate is almost flat, while the outer is more or less convex and rises towards its middle into a large conical knob, which is most distinct and most prominent on the plates which belong to the back and to the processes. The inner surface of the plates is perforated by more regularly circular holes, and upon this inner surface, which doubtless is first formed, a very fine irregular network has arisen, thus giving the plates the form described. The tentacles contain only a small quantity of deposits (Pl. XXXI. fig. 13) in the shape of small oblong perforated spinose plates and spinose irregular spicula. The deposits of the dorsal processes resemble the plates in the integument, though they are smaller and of a more irregular form; I have not been able to distinguish any spicula, though they may possibly be present in the tops of the processes which, in consequence of their brittleness, have always been broken off. The plates on the pedicels seem to be destitute of the characteristic knob, or sometimes possess a slight one; transversely disposed spicula (Pl. XXXI. fig. 12) support the ends of the pedicels, which show no traces of a terminal plate.

The calcareous ring (Pl. XXXVII. fig. 3) resembles in structure that of *Oneirophanta;* five rather large radial pieces are distinguishable, each supplied with a furrow for the passage of the ambulacral nerves and canals. From want of materials I have not been able to make a more detailed examination concerning the number of the interradial pieces. The sutures are not visible between the different pieces, and the entire ring seems to form a continuous whole of an extremely spongy structure. The polian vesicle is short and widens behind. The water-vascular system seems to bear the most striking resemblance to that of *Deima validum* and *Oneirophanta*. The cloaca is insignificant. The reproductive organ (Pl. XLVI. fig. 8) consists of two fascicles, each composed of six or seven elongated cylindrical unbranched cæca. These cæca are very hard and brittle in consequence of a great number of crowded spinose perforated plates overlapping one another (Pl. XXXV. fig. 9); these plates reach the enormous size of 0·88 mm. or more. The five longitudinal muscular bands, as well as the digestive tract and the pseudhæmal vessels, contain a number of deposits in the form of spicula or of perforated irregular plates (Pl. XXXV. figs. 7, 8, and 10).

Lætmogone, Théel.

Lætmogone, Théel, Preliminary Report on the Holothuridæ, pp. 9–10.

Tentacles fifteen, rather large, not retractile. The lateral ambulacra of the ventral surface with very large pedicels, disposed in a single row all along each side of that surface. The odd ambulacrum naked. The dorsal surface with extremely elongated, flexible, cylindrical, non-retractile processes, disposed in a single row all along each of its ambulacra. Integument with numerous wheels, and besides those deposits spicula or cruciform bodies.

Lætmogone wyville-thomsoni, Théel (Pl. XI. and Pl. XII.).

Lætmogone wyville-thomsoni, Théel, Preliminary Report on the Holothuridæ, p. 10.

Body very elongated, cylindrical or fusiform, several times longer than broad. Mouth anterior, subventral. Anus posterior, terminal, slightly dorsal. Tentacles of almost equal size; their terminal part large, thick, and sole-like, destitute of visible processes. Pedicels varying greatly in number from about fifty-six in all—twenty-nine along the left side and twenty-seven along the right—to only fifteen along each side of the ventral surface or less. Processes of each of the dorsal ambulacra rather slender, very flexible, and varying from sixteen or seventeen to about five; their length varying greatly, some being very short, others as long as the length of the body; a rather short genital process placed in the medio-dorsal line, a little behind the tentacles. Integument very thin and soft, with three kinds of calcareous deposits: scattered spicula, very large, frequently rather straight and unbranched; large wheels with about ten spokes; and smaller wheels with ten to thirteen spokes, both sorts of wheels concave, the felly being directed outwards, not on the same plane as the nave; the wheels have somewhat the form of a crown. Between the large and small wheels there are many forms, varying much in size and shape.

Colour in alcohol, lighter and darker violet, often inclining to dirty brown; ends of the tentacles leather-coloured. Length of the largest specimen, 240 mm. Breadth, about 50 or 60 mm.

Habitat.—Station 147. December 30, 1873. Lat. 46° 16′ S., long. 48° 27′ E. Depth, 1600 fathoms; bottom temperature, 0·8° C.; globigerina ooze. Three specimens. Station 158. March 7, 1874. Lat. 50° 1′ S., long. 123° 4′ E. Depth, 1800 fathoms;

bottom temperature, 0·3° C.; globigerina ooze. One specimen. Station 232. May 12, 1875. Lat. 35° 11′ N., long. 139° 28′ E. Depth, 345 fathoms; bottom temperature, 5·0° C.; sandy mud. One incomplete specimen. Station 300. December 17, 1875. Lat. 33° 42′ S., long 78° 18′ W. Depth, 1375 fathoms; bottom temperature, 1·5° C.; globigerina ooze. A great number of specimens.

The individuals belonging to this species vary greatly in size as well as in the number of pedicels and processes, and in order to give an idea of this variation I have composed the following table:—

Station.	Length of the Body.[1]	Breadth of the Body.[2]	Pedicels along the left side of the Ventral Surface.	Pedicels along the right side of the Ventral Surface.	Processes of the left Dorsal Ambulacrum.	Processes of the right Dorsal Ambulacrum.
147	145	45	22	22	7	8
147	95	...	23	22	8	9
158	20	6	15	15	5	5
300	155	50	29	27	12	9
300	150	...	17	18	11	10
300	160	...	19	22	8	11
300	160	...	20	21	9	11
300	165	...	23	19	11	11
300	185	...	23	21	17	16
300	195	60	19	19	10	8
300	200	...	19	17	7	9
300	200	...	20	22	7	6
300	200	...	17	20	11	12
300	210	...	22	21	11	11
300	210	...	18	21	11	10
300	210	55	19	20	11	12
300	220	55	21	22	8	9
300	225	...	19	19	8	8
300	230	...	18	21	11	9
300	235	...	21	22	10	9
300	240	...	24	24	12	12

Contrary to the condition in *Deima* and *Oneirophanta* the body-wall is here very thin, soft, and pliable; hence the body of this species has lost its original form greatly during preservation in alcohol. The body must have been more or less fusiform, equally tapering towards each extremity; this is best proved by filling the peritoneal cavity with alcohol or air, and thus extending the perisoma. The dorsal surface is extremely convex, while the ventral one is but slightly so. The mouth is more or less strongly inclined towards the ventral surface, and the anus, which is strikingly large, is almost terminal or indistinctly turned upwards. As the above table indicates, the number of pedicels and processes does not depend upon the size of the body; the smaller individuals are frequently provided with more numerous pedicels and processes than the larger ones. The largest specimen, about 240 mm. long, which was dredged at Station 300, has only twenty-four pedicels along each side of the ventral surface, while another individual from the same locality, which attains only the size of 155 mm., possesses twenty-nine along the left side and twenty-seven along the right one; and another form dredged at the same station, and attaining a length of 235 mm., carries ten processes along the left dorsal ambulacrum and nine along the right, while a considerably smaller specimen, only 165 mm. long, gives off eleven processes along each ambulacrum. In spite of the fact that the pedicels and processes of one side of the body generally differ in number from those of the other side, a bilateral symmetry is still traceable in their arrangement; this is especially the case with the pedicels, which in consequence of their width and great number are crowded close together side by side; while the processes, which are considerably fewer in number, are scattered irregularly along the dorsal ambulacra and only at the posterior and anterior extremities of the body show a more marked tendency to arrange themselves in pairs.

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[1] All measurements are given in millimetres.

[2] As the individuals are rather contracted, it is impossible to tell the breadth of the body exactly, wherefore I have generally omitted it.

Only a few individuals have their pedicels fully extended, and these may then attain a length of 30 mm.; they are in most cases very much contracted. The form of the pedicels is almost cylindrical, slightly wider at the base than at the free end, which terminates with a small circular disk of a lighter colour and about 1 mm. in diameter. In the same individual the processes also attain extremely various sizes, some being very short, while others on the contrary measure as much as 150 mm. in length or more. They are very elongated conical, or of an almost cylindrical form, and possess a high degree of flexibility; some of them are considerably wider than others. All of the fifteen tentacles are of an equal size, and reach in their fully extended state a length of 20 mm.; their base is slightly wider, and measures about 6 mm. in diameter. The end of the tentacles is dilated into a thick leathery disk of a light brown colour, on which no processes are distinguishable, unless the insignificant prominences round its edge are to be regarded as such; its surface is uneven and as if wrinkled. It is probable that when the tentacles are fully extended those prominences may be larger, but in all the thirty to forty individuals which I examined, the ends of the tentacles were destitute of true processes as is described above (Pl. XXXIX. fig. 4).

The calcareous deposits (Pl. XXXI. fig. 14–16) present two forms: spicula and wheels. The former have a length of 0·38 mm., are usually simple, straight, or slightly curved, and give off sometimes one or several branches; towards each end they carry some minute spines, which are sometimes found scattered over the whole of the spicula. Excepting in the ends of the pedicels, processes, and tentacles, the spicula are only present on the ventral surface. The wheels offer a great many variations, the largest measuring about 0·14 mm. in diameter, while the smallest only reach a size of 0·04 mm.;

and between these two an immense series of gradations exists. The short and arcuate spokes—in the large wheels from eight to ten in number, or sometimes less, while the smaller wheels have twelve or thirteen—support a large, discoidal nave with a large hole in its middle, from the edge of which proceed five, sometimes four or six, small slightly arcuate rods, which converge to form a conical figure, the top of which is directed towards the inside of the body-wall. The wheels are concave, more or less like a crown, and have their felly directed outwards from the body. The ventral perisoma is almost exclusively strengthened by small wheels which are usually rather scattered, whereas wheels of all dimensions are to be seen on the dorsal surface; nowhere are these deposits so crowded as in the tentacles and processes. The wheels lie in the outer layer of the connective tissue, while the spicula are placed close to the layer of circular muscular fibres. Besides those above-mentioned deposits I have found here and there, though especially in the processes, some minute, round bright particles, and numerous slightly larger bodies of a discoidal form; these are doubtless chemical products which have originated by preservation in alcohol. The layer of connective tissue of the integument contains an immense quantity of violet pigment which is partly scattered, partly crowded in masses, and partly disposed in lines which cross one another in all directions, thus forming an obvious network; the large nerve-cords as well as their ramifications contain pigment, and the pigmented network just mentioned is constituted by them.

The sole-like terminal part of the pedicels is strengthened either by a single, large, more or less circular perforated plate (Pl. XXXIV. fig 1), with the holes in the centre considerably larger than at the circumference, or by some smaller ones; round these plates lie partly some short, thick spicula of a variable shape, which are often provided with branches, and have their slightly enlarged ends spinose, and partly longer arcuated unbranched ones. The processes contain, besides a multitude of wheels of various dimensions, some scattered spicula. The ends of the tentacles are supported by a great number of unbranched spicula of diverse forms and dimensions resembling those of the pedicels; the stem of the tentacles, however, contains only a few scattered spicula but a greater number of wheels.

The calcareous ring (Pl. XXXVII. fig. 11) seems to be made up of a continuous spongy, extremely fragile and thin network, no radial and interradial pieces being distinguishable. By treating it with a solution of potass it separates into small pieces or fragments. The very pliable ring is capable of being considerably contracted, thus forming numerous larger or smaller wrinkles. The polian vesicle, 20 mm. long, has a considerable width. The ambulacral cavities (Pl. XLII. fig. 7) are small, and do not give off any branches; their form is more or less evidently triangular, or approaches almost the shape of a semicircle. The madreporic canal (Pl. XLIII. fig. 4*a*) presents the greatest difference when compared with that of *Oneirophanta;* it runs out, as usual, from the dorsal portion of the circular vessel, and passes upwards and backwards to the body-wall, where, surrounded by a thick layer of connective tissue, it joins the medio-dorsal line about 30 mm. behind the tentacles. When the tube reaches the perisoma it gives off four to five, sometimes even as many as nine (Pl. XXXVIII. fig. 9), very narrow branches, which pierce the body-wall and open externally each at the top of a minute papilla. These papillæ, measuring from 2 to 3 mm. in length, are closely crowded together at the base of the genital process, which is situated anteriorly in the medio-dorsal line, and which is in connection with the efferent duct of the reproductive organ. The position of those papillæ is various; sometimes they are placed immediately in front of the genital process, sometimes they form a semicircle along one side of it. Through the openings in the free ends of the papillæ the ambulacral system communicates with the surrounding medium. The deposits of the madreporic canal consist partly of scattered more or less aggregated, minute, slender, straight or curved, branched or unbranched irregular rods, partly of a few irregular wheels differing more or less from those in the integument, and finally of a few irregular perforated plates in the form of a network.

The posterior portion of the digestive tract is generally slightly enlarged, excepting in some individuals dredged at Station 147; two of these possess a large cloaca, which in one of them gives off a cæcal prolongation on the left side; in two other specimens from the same locality the cloaca is almost imperceptible. The parietes of the alimentary canal as well as the walls of the pseudhæmal vessels contain calcareous deposits in the form of spicula (Pl. XXXVI. fig. 3). The reproductive organ (Pl. XLIII. fig. 4, *g*) consists of two large fascicles made up of bundles of small oval cæca (Pl. XLVI. figs. 2 and 3), one fascicle on each side of the dorsal mesentery; its efferent duct opens externally by a pore situated on the top of the aforesaid process which has its place in the medio-dorsal line and reaches a length of 11 mm., and a diameter, at the base, of 2·5 mm. This genital process has sometimes a branch projecting from its side, the efferent duct thus having two apertures (Pl. XXXVIII. fig. 9); sometimes the top of the process is divided into four small branches, only two of which seem to communicate with the efferent duct (Pl. XXXVII. fig. 5). I have only once met with an individual provided with two equally large processes side by side, and in which consequently the common duct must have divided while piercing the perisoma. Thus it is of importance to remember that both the reproductive organ and the madreporic canal are subject to considerable variations in their manner of terminating.

As the above description is taken from the individuals which were obtained at Station 300, it is necessary to point out the more or less important characters which distinguish the specimens brought home from other stations. The individual from Station 232 was in such an incomplete state that no close examination is possible; it is only 25 mm. long, and has thirteen developed tentacles and rudiments of a fourteenth; it is most probable that this form is a distinct species from *Lætmogone* *wyville-thomsoni*, and this seems still more likely on considering the nature of the sea-bottom and the comparatively inconsiderable depth where the animal was found living.

The single specimen, obtained from Station 158, is distinguished by the strong convexity of the dorsal surface, the height of the body being considerably greater than the breadth, which may possibly be the result of contraction.

The four individuals brought home by the Challenger expedition from Station 147 may possibly be regarded as "varieties." Their colour is darker than in the typical form, and their tentacles are almost black. In one specimen the odd ambulacrum carries posteriorly a couple of small pedicels. The genital process is inconsiderable. One individual possesses a large cloaca which gives off a cæcal prolongation towards the left side, while another specimen has likewise a large cloaca but without any cæcal prolongation. In the two remaining individuals the posterior portion of the alimentary canal resembles that of the typical form. The calcareous deposits of the ventral perisoma, especially the spicula, are much more numerous, and the ends of the dorsal processes are strengthened by a greater number of straight or arcuated spinose spicula, than is the case in the typical form.

Lætmogone violacea, Théel (Pl. XIII.).

Lætmogone violacea, Théel, Preliminary Report on the Holothuridæ, p. 11.

Body elongated, about twice and a half as long as the greatest breadth. Mouth anterior, subventral. Anus posterior, terminal, slightly dorsal. Tentacles of almost equal size; their terminal part rather large, almost discoidal, destitute of visible processes. Pedicels eleven along the left side of the ventral surface, and twelve along the right, rather long and large; the posterior pairs small. Processes of the dorsal surface very slender and flexible, in one individual twenty, in another twenty-three along each of the ambulacra; the largest process about as long as the greatest breadth of the body; a rather short genital process placed in the medio-dorsal line, a little behind the tentacles. Integument very thin and rough, with four sorts of numerous calcareous deposits: scattered spicula; spinose bodies, cruciform or in the form of an X, with the four arms curved; large wheels frequently with eight spokes; and small wheels, sometimes with thirteen spokes. Both sorts of wheels resembling those of the preceding species; between the large and small wheels there are many forms, varying much in size and shape.

Colour in alcohol, grey violet. Ends of the tentacles light yellowish-brown. Length, about 90 mm. Breadth, about 35 mm.

Habitat.—Station 164. June 12, 1874. Lat. 34° 8′ S., long. 152° 0′ E. Depth, 950 fathoms; bottom temperature, 2·2° C.; grey ooze. Two specimens.

During the cruise of the "Knight Errant" between the Faröe Islands and the coast of

Scotland, in the summer of 1880, Mr Murray brought home a rich collection of very interesting abyssal forms, among which I was much surprised to find a great abundance of *Lætmogone violacea.* More than a hundred specimens were obtained at Station 4, August 10, at a depth of 555 fathoms.

This species differs externally from the preceding one by the considerably smaller dimensions of its body and by the greater number of its dorsal processes, which in general do not attain a great length. As the Holothurids dredged by Mr Murray during the cruise of the "Knight Errant" have been placed at my disposal, I have had an opportunity of noticing that the number of processes and pedicels even in these specimens is rather variable, though it seems generally to approach that stated in the diagnosis. The discoidal ends of the tentacles, about 4·5 mm. in diameter, present in resemblance to those of the preceding species no other traces of processes than a few minute protuberances round their edges. The pedicels are very large, and measure at their base about 8·5 mm. in diameter. The dorsal processes, on the contrary, are very slender and of an elongated conical shape, measuring at the base about 3 mm. in diameter; they vary greatly in size, and sometimes attain a length of 30 mm. or more. Like the pedicels, they are highly flexible, but want the power of retraction; however, they are able to be more or less contracted. The processes are arranged in a single row along each ambulacrum except anteriorly, where the two or three first of each side frequently—though not always—are disposed in a transverse row, the two next following being also placed side by side. The animals are in such a state of contraction that I am somewhat uncertain as to the arrangement of those anterior processes. The perisoma is thinner and more transparent than in *Lætmogone wyville-thomsoni*, and is not so abundantly pigmented. The spicula (Pl. XXXVI. fig. 24), which apparently only exist on the ventral surface, are scattered, simple, spinose, and reach a length of about 0·16 mm. The wheels are found of all dimensions everywhere in the integument, and resemble perfectly those of the above-mentioned species; the smaller ones have as many as thirteen spokes and a diameter of about 0·036 mm.; the larger ones (Pl. XXXVI. fig. 20), on the contrary, attain to about 0·2 mm. in diameter, and possess usually eight to nine spokes; the spokes being strongly arcuated, the nave does not lie on the same plane as the felly but inside it. From the edge of the considerable hole in the centre of the nave, proceed commonly four minute rods running together to a point. The wheels have the appearance of a crown with the concave side turned outwards. The largest wheels are found in the parietes of the processes and in the dorsal perisoma, though they are more thinly scattered in the latter. The cruciform spinose bodies (Pl. XXXVI. fig. 21) in their most developed state reach about 0·2 mm. in diameter, while the smallest ones measure only about 0·072 mm., and they are very numerous on the dorsal surface, whereas they are found more scattered and commonly smaller on the ventral one; the arms of those deposits are more or less strongly arcuated and extremely spinose, and their slightly enlarged ends are directed outwards from the body, thus making the integument very rough. Here and there such bodies composed of three or five arms are to be distinguished. There is no difference in the individuals brought home by the "Knight Errant" with regard to the size and number of the cruciform bodies of the dorsal and ventral surfaces, but it is worthy of note that those deposits are more irregular and differ more frequently from the typical four-armed form, a greater number of them being formed by three, five, or six arms than is the case in the examples dredged at Station 164. In the pedicels, processes, and tentacles a smaller or greater number of wheels and X-shaped bodies are distinguishable. The ends of the pedicels are provided with a perforated terminal plate—sometimes only fragments of the plate are visible—which gives the impression of being hollowed and concave outwards with its edge thick and of a more irregular net-like structure; round this plate a number of straight or slightly curved unbranched spicula is crowded, most of which are rather large and thick and towards the spinose ends either acute or obtuse (Pl. XXXVI. fig. 22). The walls of the dorsal processes contain scattered spicula, and the terminal discoidal part of the tentacles is strengthened by a great number of extremely arcuated ones (Pl. XXXVI. fig. 23).

The water-vascular system resembles that of the preceding species; however, the ambulacral cavities of the pedicels are in this form narrower and more elongated (Pl. XLII. fig. 2). The madreporic canal is supported by calcareous deposits of irregular shape, which constitute a particularly strong network where the tube clings to the body-wall. The madreporic tube terminates in several minute canals, which pierce the perisoma and open externally close to the base of the genital process.

The calcareous ring forms as in *Lætmogone wyville-thomsoni* a continuous whole round the gullet, and does not appear to be composed of separate ossicles; only a more solid structure marks the position of the radial pieces.

Lætmogone spongiosa, Théel (Pl. XIV.).

Cryodora spongiosa, Théel, Preliminary Report on the Holothuridæ, p. 9.

Body elongated, almost cylindrical, and of equal breadth throughout, about four times as long as broad. Mouth anterior, subventral. Anus posterior, subdorsal. Tentacles of almost equal size, their terminal part large and discoidal, destitute of visible processes. Pedicels fourteen along the left side of the ventral surface, and fifteen along the right, the posterior ones very small and indistinct. Processes of the dorsal surface eighteen along the right and seventeen along the left ambulacrum, rather long, very soft and flexible; the four anterior on each side not in a row after one another, but two and two, side by side. Integument very thick, soft and spongy with three sorts of calcareous deposits: wheels, spicula, and four- or five-armed spinous, starlike or cruciform bodies.

Colour in alcohol, light sea-green; top of the tentacles light brown. Length, 135 mm. Breadth, 35 mm.

Habitat.—Station 235. June 4, 1875. Lat. 34° 7′ N., long. 138° 0′ E. Depth, 565 fathoms; bottom temperature, 3·3° C.; mud. One specimen.

On first examining this form, I was surprised to find neither calcareous deposits in the body-wall nor any calcareous ring surrounding the gullet; besides, the thickness of the perisoma as well as its spongy structure were very striking indeed, and on account of this I at first thought myself justified in founding a new genus. After a renewed examination, however, I was convinced that calcareous deposits as well as the calcareous ring are really present, though the calcareous substance for some reason or other had been dissolved, most probably by some impurity in the alcohol. By making horizontal sections of the perisoma, and treating them with hæmatoxylin, the extremely thin sheaths which envelope the deposits become visible; and by studying the integument most carefully in this manner I have been able to distinguish three forms of deposits closely resembling those in *Lætmogone violacea,* which species bears the strongest resemblance to the present one. The genus *Cryodora* must accordingly be annulled.

Some of the tentacles are considerably smaller than others. The dorsal processes vary in size, sometimes attaining a length of 25 to 30 mm. and a diameter at the base of about 5 mm. Wherever a process protrudes from the body the perisoma rises, and thus the processes appear as if they ran out from low ridges. The pedicels are especially wide and long. It is impossible to make a detailed examination of the form and the number of the calcareous bodies. The cruciform or star-like deposits (Pl. XXXIX. fig. 6) which seem to be the most numerous, present a rather irregular form and measure about 0·22 mm. in diameter; their arms are rather arcuated and provided with large spines. I have not been able to distinguish any small wheels, though they may probably be present; the wheels which I made out measure about 0·24 mm. in diameter (Pl. XXXIX. fig. 5).

Traces of a calcareous ring are found in the form of an extremely fine network of minute tubes, the calcareous substance ensheathed by the tubes being now dissolved. The madreporic canal opens externally by ten minute pores, which lie close together in the medio-dorsal line immediately in front of the inconsiderable genital process about 20 or 23 mm. behind the anterior extremity of the body. The polian vesicle is short, and measures only 15 to 20 mm. The anal termination of the alimentary canal presents only a slight cloacal dilatation.

The resemblance between this species and the preceding one is most striking, and the only more important character which distinguishes them from one another seems to be the thickness of the perisoma in *Lætmogone spongiosa;* it is, however, not impossible that the thickness of the integument may depend upon its maceration in impure alcohol, in which case this characteristic peculiarity would also vanish. My opinion is, that until we obtain better material, and are enabled to determine with certainty the form and number of the calcareous bodies, it is safest to regard these two forms as belonging to different species.

Orphnurgus, Théel.

Orphnurgus, Théel, Preliminary Report on the Holothuridæ, p. 8.

Tentacles twenty, rather large, non-retractile. The lateral ambulacra of the ventral surface with very large pedicels, disposed in a single row all along each side of that surface, and with another series of slender, flexible processes, placed above the pedicels, all along each side of the body. The odd ambulacrum naked. The dorsal surface with a crowded series of numerous processes, resembling those of the ventral lateral ambulacra, apparently disposed in two rows all along each of its ambulacra. Integument with spicula of various forms.

Orphnurgus asper, Théel (Pl. XV.).

Orphnurgus asper, Théel, Preliminary Report on the Holothuridæ, p. 8.

Body very elongated, of almost equal breadth throughout, several times longer than broad. Mouth anterior, terminal, slightly ventral. Anus posterior, slightly dorsal. Tentacles of almost equal size; one smaller than the others, with its terminal part torn off; ends of the tentacles with several retractile branched processes. Pedicels twenty-three along each side of the ventral surface, very large and long; the posterior ones smaller. Number of processes along the lateral ambulacra of the ventral surface almost the same as that of the pedicels. Processes of the dorsal ambulacra very numerous, in all about one hundred and fifty. The length of the slender and flexible processes variable, the largest ones nearly as long as the breadth of the body. Integument hard and rough, with numerous small, short spicula of various shapes, some smooth, others provided with numerous large spines or processes.

Colour in alcohol, light grey. Length, about 170 mm. Breadth, about 35 mm.

Habitat.—Station 23. March 15, 1873. Off Sombrero Island. Depth, 450 fathoms; globigerina ooze. One specimen.

The only specimen which I have had at my disposal was extremely incomplete and much contracted and wrinkled, so that it was rather difficult to ascertain exactly its true aspect, but I believe that my figures present a pretty correct idea of its shape. The body is very elongated and of almost equal width throughout. The ventral surface is almost flat, while the dorsal one, on the contrary, is convex. The anal aperture is very large.

On account of the contraction of the dorsal perisoma it is impossible to state exactly the position of the processes in correspondence with one another as well as with the pedicels. The processes, about two hundred in number, including those of the ventral lateral ambulacra, are of an elongated conical form, and the largest measure about 25 to 30 mm.

in length. The almost cylindrical pedicels, 18 to 20 mm. long, measure at their base 6 mm. in diameter; their ends are truncated, slightly rounded, and measure about 4 mm. in diameter. The tentacles (Pl. XLIV. fig. 3), of which a dorsal one on the right side is rudimentary, terminate in several, commonly four, large, branched retractile processes, which carry a number of small papilla-like projections on their inner side which is directed towards the mouth.

The perisoma, though not particularly thick, is hard and rough on account of the great number of spinose calcareous bodies which it contains. The shape of these deposits (Pl. XXXIV. fig. 15) is very various, and they are generally made up of strongly spinose spicula, which are sometimes provided with one or several small holes. The dorsal spicula are slightly larger, about 0·14 mm. to 0·2 mm. in length, and more numerous than the ventral ones, and have their spines thicker and in greater abundance. Besides this form of deposit I have found some scattered straight or slightly curved rod-like spicula, which are considerably longer than the former ones, and are either totally destitute of spines or are furnished with some minute ones at their ends. These rods, which sometimes reach a length of 0·46 mm., are more thinly scattered in the dorsal perisoma, where they even attain a very considerable size. The deposits of the pedicels (Pl. XXXIV. fig. 16), likewise of two different kinds, consist partly of spicula of the same shape as those of the dorsal surface, though smaller and with shorter spines, partly of larger, about 0·9 mm. long, straight or slightly curved rod-like ones, which are smooth excepting their slightly enlarged and truncated ends. The former ones lie closely crowded in the outwardly directed wall, but are very thinly scattered in that part of the pedicel which is directed towards the ventral surface. The latter, the rod-like spicula, on the contrary, are arranged in two longitudinal series, one along the anterior side of the pedicels and the other along the posterior one, each series containing four to six such rods, side by side. The end of the pedicel is destitute of a terminal plate, but is supported by a number of larger or smaller, more or less curved spicula, the ends of which give off small spines. The processes, also, are strengthened by two longitudinal series of rod-like spicula resembling those in the pedicels; the spaces between those two series are extremely poor in deposits. The ends of the tentacles contain larger or smaller, more or less arcuated, spicula of the same appearance as those in the ends of the pedicels.

The polian vesicle, measuring about 65 mm. in length, is widest in the middle, and decreases almost equally towards its extremities. The madreporic canal runs upwards and forwards and terminates in a madreporic plate or tubercle (Pl. XXXVIII. fig. 10), which is composed of a solid calcareous network, and has coalesced with the inside of the dorsal perisoma about 15 mm. from the anterior extremity of the body. The canal being invested by the medio-dorsal mesentery is bond-like and strengthened by a network of fine calcareous threads along the one side, while the other side has no such network. In the connective tissue, which surrounds the canal, some scattered, rather large, more or less straight spicula are found, the ends of which are frequently provided with smaller processes or spines. The madreporic tubercle is divided by the medio-dorsal mesentery into two halves, each being flat, of an ovate form, and strongly concave along its middle, and having a length of about 4·5 mm.; the free surface through which the ambulacral system communicates with the peritoneal cavity is uneven on account of a number of wrinkles and papillæ. The large and branched ambulacral cavities of the pedicels, which lie enclosed within the body-wall, give off each a short, wide, somewhat branched cæcal prolongation or vesicle, which depends freely into the peritoneal cavity (Pl. XLI. fig. 3). The processes of the dorsal as well as of the ventral lateral ambulacra communicate exclusively with these branched vesicles. The reproductive organ is composed of two fascicles, each consisting of about twenty larger and smaller oval cæca; those fascicles communicate with a short, wide tube on each side of the medio-dorsal mesentery, which tubes pass into a common efferent duct which opens externally by a pore situated about 25 mm. from the anterior extremity of the body.

Ilyodæmon, Théel.

Ilyodæmon, Théel, Preliminary Report on the Holothuridæ, pp. 11, 12.

Tentacles fifteen, rather large and non-retractile. The lateral ambulacra of the ventral surface with large pedicels, apparently disposed in a double row all along each side of that surface. The odd ambulacrum naked. The dorsal surface with a crowded series of very numerous, retractile, slender, rather long processes, disposed in three or four irregular, close-set rows all along each of its ambulacra. Integument with numerous wheels and dichotomously branched bodies.

Ilyodæmon maculatus, Théel (Pl. XVI.).

Ilyodæmon maculatus, Théel, Preliminary Report on the Holothuridæ, p. 12.

Body elongated, of almost equal breadth throughout, about thrice as long as broad. Mouth anterior, almost ventral. Anus posterior, subdorsal. Tentacles of nearly equal size, with large circular discoidal ends, bearing round their edge small rudimentary processes; the ventral tentacles of one individual a little smaller. Pedicels of each side of the ventral surface varying in number from about twenty-nine to about eighteen; the posterior pairs smaller. Pedicels of the inner row apparently alternating with those of the outer. Processes of each of the dorsal ambulacra very numerous, about one hundred and forty to one hundred and fifty, cylindrical or fusiform; the largest as long as the breadth of the body. Back naked along its middle between the processes of both the ambulacra, except anteriorly a little behind the tentacles, where there is a small genital process. Integument thick and soft, with three sorts of calcareous deposits very numerous: large wheels, 0·14 mm. in diameter, and with about nine spokes; small wheels, 0·036 mm. in diameter, and with about twelve spokes; and irregularly rounded flat discoidal plates, dichotomously branched, nearly of the size of the small wheels, crowded in large numbers in several places. Wheels concave, with the felly directed outwards, and the nave towards the inside of the body; between the large and small wheels there are many forms, varying much in size and shape.

Colour in alcohol, white grey, with scattered white spots caused by the crowded calcareous deposits; back and sides with numerous small, dark red, or brown points and spots; processes with a reddish band and frequently with dark red tops; terminal parts of the tentacles brown. Length, about 130 mm. Breadth about 45 mm.

Habitat.—Station 209. January 22, 1875. Lat. 10° 10′ N., long. 123° 55′ E. Depth, 95 to 100 fathoms; bottom temperature, 21·7° C.; mud. Three specimens. Station 219. March 10, 1875. Lat. 1° 50′ S., long. 146° 42′ E. Depth, 150 fathoms; mud. Two incomplete specimens. Station 192. September 26, 1874. Lat. 5° 42′ S.; long. 132° 25′ E. Depth, 129 fathoms; mud. Two individuals.

The individuals obtained at Stations 209 and 219 are extremely incomplete, having the alimentary canal totally destroyed and various portions of the body-wall torn quite in pieces. Only a single specimen is in such a state of preservation that it is possible to get a correct idea of its general appearance. After finishing the examination of those individuals, I obtained two specimens from Station 192 in a rather more complete state. The body appears to be almost equally broad throughout, becoming slightly wider and more evenly rounded anteriorly than posteriorly; the back is very convex, while the ventral surface is nearly flat. The mouth is on the ventral surface, and the anus is terminal and situated above the posterior pedicels and ought consequently to be regarded as belonging to the dorsal surface. The tentacles seem as a rule to be of equal size, though the ventral ones are sometimes slightly smaller; their free end is almost discoidally dilated, about 7 mm. in diameter, and forms a sharp edge which obviously separates the end itself from the supporting stem. This edge (Pl. XLIV. fig. 11) is crenulated with minute incisions and lobes, and on its outer side a more evident incision is often seen. As in *Lætmogone*, the tentacles seem to want true processes. One of the dorsal tentacles of one individual is incompletely developed, its terminal part being acute.

The largest individual, measuring 130 mm., has twenty-nine pedicels along the left side of the ventral surface, and probably about the same number along the right, though I feel somewhat uncertain concerning it, as a portion of this side is torn off. Another individual carries about twenty-three pedicels along each side, while a third specimen gives off twenty-six along the left and twenty-four along the right side of the ventral surface. Both of the specimens from Station 192 are likewise supplied with a variable number of pedicels, one possessing eighteen along the left and twenty along the right side, while the other carries eighteen on the left and nineteen along the right side; consequently, the number of pedicels in this species seems to be subject to considerable variation. All the pedicels, excepting the foremost and hindmost ones, of the largest and most developed individuals are evidently disposed in a double row along each side of the ventral surface, those of the inner row alternating with those of the outer row; this arrangement of pedicels in double rows is less obvious in the younger animals. The pedicels reach a considerable size, the largest being about 15 mm. in length and about 8 mm. in diameter at the base. The dorsal processes of the largest individual are very numerous and disposed in about four very irregular rows along each ambulacrum, though anteriorly and posteriorly only two rows are distinguishable. This disposition of the processes appears most plainly on examining their vesicles from the inside of the perisoma. A narrow area along the middle of the back is destitute of processes except anteriorly where a minute one is situated, the importance of which I shall discuss further on. The individuals from Station 192 are distinguished from the others by possessing only two rows of processes along each of the dorsal ambulacra. The fusiform or conical processes are extremely flexible and of variable size, the largest measuring about 35 mm. in length and 7 mm. in diameter at the base (Pl. XLII. fig. 3).

The integument is very thick, and rather soft and pliable. The ventral perisoma contains apparently nothing but small wheels (Pl. XXXVI. fig. 17) and dichotomously branched bodies (Pl. XXXVI. fig. 18); the former are more numerous and closely-crowded, while the latter are partly scattered, partly agglomerated, thus becoming visible to the naked eye as larger and smaller white spots or dots. The deposits of the sides of the body almost correspond with those of the ventral surface, except in the neighbourhood of the dorsal processes where large scattered wheels are found. The dorsal perisoma between the series of processes is supported by a great many large wheels, while the small wheels and the dichotomously branched bodies are there fewer in number. The small wheels measuring about 0·028 mm. in diameter resemble those in *Lætmogone*, except that the hole in the centre is larger, the nave forming consequently a slender ring, from the inner edge of which commonly four minute rods run out; the number of spokes is generally twelve. The large wheels (Pl. XXXVI., figs. 12–15), from 0·14 mm. to 0·2 mm. in diameter, remind one likewise of those of the above-mentioned genus, the felly as well as the spokes being however more strongly developed; the spokes, nine in number, are attached to the posterior inner portion of the felly, and a transverse section of them presents almost the form of a triangle. The crown of those large wheels, made up of six minute rods, rises from the inner margin of the nave and sends out from its top a process of larger or smaller dimensions, which sometimes is simple as in *Lætmogone*, but often supports a triangular figure, the three acute corners of which lie on the inner margin of the nave. The dichotomously branched bodies are discoidal and more or less circular; their appearance will be most easily understood by looking at my figures. The three above-mentioned forms of deposit are found present in more or less abundance even in the pedicels, processes, and tentacles. The end of the pedicels is strengthened by a terminal perforated plate, surrounded by numerous transversely placed spicula (Pl. XXXVI. fig. 19), which decrease in number towards the middle of the pedicel, where they cease totally. These spicula are fusiform, rather long and slender, straight or arcuated, with their ends more or less spinose, a few being branched, and others enlarged in the middle and punctured with one or more holes. The dorsal processes have only a few scattered spicula which do not lie crowded together at their tops. Many more or less arcuated spicula of very variable size are present in the tentacles. The deposits of the oral disk are partly made up of wheels of various dimensions and dichotomously branched bodies, partly of simple or branched, straight or slightly curved spinose spicula which have sometimes a cruciform shape.

The calcareous ring forms a continuous whole of an extremely fragile and spongy structure, which a solution of potass separates into pieces, though not into distinctly regular ones. The posterior part of the ring, or that portion which is directed upwards, when in its proper position, is penetrated by five rather large holes. The polian vesicle is unusually small, only 6 mm. long. The madreporic canal (Pl. XXXVIII. fig. 6) communicates with the exterior by a number of pores, from eight to about fifty, situated close together immediately in front of the genital process, and about 20 mm. behind the anterior extremity of the body. When the number of pores is great, they are closely crowded on a small space, which being slightly depressed below the surface of the surrounding perisoma, becomes strikingly like a madreporic plate (Pl. XXXVIII. fig. 7). These pores communicate with a corresponding number of minute canals which pierce the perisoma and open into a comparatively thick madreporic tube. The above-mentioned canals often bear one or more branches, and their walls contain numerous dark violet pigment cells, thus becoming most conspicuous; they are often of a flask-shaped form, and completely wanting in calcareous deposits. The madreporic canal itself is strengthened by a great number of thread-like, irregularly branched calcareous bodies (Pl. XXXVIII. fig. 8) of variable size. The pedicels communicate with ambulacral cavities, while the processes, on the contrary, are in connection with ambulacral vesicles. The spacious ambulacral cavities, which are elongated and lie in the thick layer of connective tissue of the ventral perisoma, are of two kinds according as they belong to the pedicels of the inner or outer row; those in connection with the pedicels of the outer row are widest where they communicate with the ambulacral vessels, while the other cavities are here comparatively much narrower, but increase in such a manner, that their greatest width is at a considerable distance from the ambulacral vessels. Both kinds of ambulacral cavities (Pl. XLII. fig. 4) terminate in several short cæcal prolongations.

which approach more or less the medio-ventral line. The ambulacral vesicles of the processes (Pl. XLII. fig. 3) resemble large sacks, from 10 mm. to 15 mm. long, which hang freely into the peritoneal cavity. A number of more or less spacious cavities and lacunæ which are found in the perisoma ought probably to be considered as belonging to the water-vascular system. The reproductive organ (Pl. XLVI. fig. 1) is composed of numerous bundles of cæca forming two fascicles, separated from one another by the medio-dorsal mesentery; its common efferent duct opens externally at the top of the above-mentioned genital process, which is situated immediately behind the pores of the madreporic canal; the organ attains a length of 40 mm., and its walls contain scattered spicula.

As the above description is taken from the largest individual, obtained at Station 209, it is necessary to note the peculiarities which characterise the specimens from the other localities. Those dredged at Station 219 attain a comparatively small size, the largest measuring about 80 mm. in length; their dorsal processes are not very numerous and are disposed in a single slightly irregular row along each ambulacrum; one of the individuals has only twelve tentacles, which evidently must be regarded as an abnormity; the large wheels are more numerous than in the large specimen dredged at Station 209. As is pointed out above, the individuals from Station 192 differ slightly from the typical form; their pedicels are not so obviously arranged in double rows, and only two distinct rows of dorsal processes are present along each ambulacrum; their deposits are made up of an enormous number of dichotomously branched bodies, which are not aggregated in such masses as to form white spots; their small and large wheels are very scattered. The alimentary canal, which is uninjured in these individuals, has no cloaca of importance.

Pannychia,[1] n. gen.

Tentacles twenty, rather large and non-retractile. The lateral ambulacra of the ventral surface with large pedicels, disposed in a single row all along each side of that surface. The odd ambulacrum with a double row of pedicels. The dorsal surface with a crowded series of very numerous, slender processes all along each side. Integument with numerous wheels and small wheel-shaped plates.

Pannychia moseleyi, n. sp. (Pl. XVII.).

Body elongated, almost cylindrical, several times longer than broad. Mouth anterior, subventral. Anus posterior, terminal. Tentacles of nearly equal size; their large, circular discoidal ends bearing round their edge small rudimentary processes. Pedicels thirty along the left side of the ventral surface, and twenty-nine along the right one. The odd ambulacrum with fifty-five pedicels, smaller than the former, and disposed in a double row. Processes of each side of the dorsal surface numerous, about one hundred; the largest as long as half the breadth of the body. The anterior part of the back with a transverse, thin, lobe-like extension of the skin, sending out several processes. Integument rather thin with two sorts of calcareous deposits: large wheels, 0·24 mm. in diameter, with eleven to thirteen spokes; and small wheel-shaped plates, 0·052 mm. in diameter, with about fifteen holes.

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[1] Νύξ = night.

Colour in alcohol, white grey; back dark violet, with the small processes and the top of the larger ones whitish; terminal parts of the tentacles and pedicels yellowish. Length, about 200 mm. Breadth, about 40 mm.

Habitat.—Station 164. June 12, 1874. Lat. 34° 8′ S., long 152° 0′ E. Depth, 950 fathoms; bottom temperature, 2·2° C.; grey ooze. One specimen. Station 169. July 10, 1874. Lat. 37° 34′ S., long. 179° 22′ E. Depth, 700 fathoms; bottom temperature, 4·2° C.; grey ooze. One specimen.

Although I have only had the opportunity of examining a single tolerably complete individual from Station 164, and a very defective one dredged at Station 169, I do not doubt that the variation in the number of pedicels and processes is considerable. The terminal part of the tentacles is covered with minute papilla-like projections, and, as noted in the diagnosis, one pair of small processes on the outer margin seems to be larger than the others. The pedicels of the odd ambulacrum are considerably smaller than those of the lateral ambulacra, some of them being almost rudimentary. The form of the pedicels is truncated conical, with the large rounded terminal part leathery, and measuring up to 4 mm. in diameter. The lobe-like transverse appendage on the back anteriorly is rather indistinct and macerated; it is difficult to distinguish its true shape, and from its thinness and slight height I was at first sight inclined to think that it was a piece of the outer layer of the perisoma which had been torn off and had attained that form, but on noticing its clearly marked edge and its processes, I was convinced that it was a real lobe-like appendage. The numerous dorsal processes form two longitudinal series, one along each side of the back, leaving a rather broad naked area between them; each series contains several processes side by side, though their arrangement in rows is imperceptible. Judging from the ambulacral cavities or vesicles it is evident that some of those processes belong to the lateral ambulacra of the ventral surface. The largest processes attain a length of 15 to 20 mm., but most of them, being minute and almost rudimentary, are only visible as lighter spots.

The large wheels (Pl. XXXII. fig. 1), 0·24 mm. in diameter, are almost visible to the naked eye; they are provided with eleven to thirteen spokes, and their large nave is perforated by a more or less round central hole, from the edge of which projects a crown constructed of four slightly curved arms. The wheels being slightly convex, the top of the crown lies inwards, while the felly is directed outwards; between the spokes the felly carries round lobes, the number of which is similar to that of the spokes. The large wheels are most numerous in the walls of the processes and in the dorsal perisoma, and are on the contrary very scattered on the ventral surface and in the pedicels and tentacles. Those large wheels of the individuals dredged at Station 169 are provided with up to fifteen spokes, and with a crown constructed of from five to six arms; instead of the large hole in the centre of the nave, there are frequently found several very small ones, in which case the centre of the nave is joined to the top of the crown by a short minute rod (Pl. XXXII. fig. 6). The small wheel-shaped plates (Pl. XXXII. fig. 5), about 0·052 mm. in diameter, are slightly convex and perforated by about fifteen holes, of which the four central ones are larger than the others which surround them; these plates, which are sometimes provided with five central holes, are found everywhere in the perisoma.

The processes and pedicels contain, besides the above-mentioned forms of deposits, partly larger, scattered round plates (Pl. XXXII. figs. 7) which measure about 0·072 mm. in diameter, and are supplied with from thirty-five to fifty holes, partly a few straight or arcuated simple or branched spinose spicula (Pl. XXXII. fig. 9); in addition, one or more large plates of a more irregular form are distinguishable at the top of the processes (Pl. XXXII. fig. 8). The terminal part of the pedicels is strengthened by several layers of calcareous bodies, the innermost of which is most developed and made up of plates (Pl. XXXII. figs. 11, 12) perforated by numerous round holes, which decrease in size towards the uneven circumference; outside those lie fragile and net-like bodies with wide irregular meshes. The oral-disk is provided with numerous simple, more or less straight and spinose spicula, with the ends sometimes bipartite. The calcareous ring is rudimentary, fragile, and spongy; it has not been possible to distinguish its true form and structure.

The polian vesicle, large and wide, measures about 27 mm. in length. The madreporic canal seems to communicate with the exterior by several pores, though from want of material I do not feel convinced about it; its walls contain a thin thread-like calcareous network (Pl. XXXII. fig. 13). The pedicels are in connection with elongated ambulacral cavities within the perisoma, while the processes communicate with small branched vesicles hanging into the peritoneal cavity. The reproductive organ is composed of two large fascicles about 60 mm. in length, which are situated one on each side of the medio-dorsal mesentery; each fascicle is made up of several bundles of dichotomously branched, elongated, cæcal sacks. The genital aperture is situated about 30 mm. behind the tentacles.

Family III. PSYCHROPOTIDÆ.

Body more or less elongated, either subcylindrical and vermiform, or very flat and depressed, or rather high posteriorly and decreasing gradually forwards; its anterior part always rather depressed. The perisoma along the sides of the body, as well as round its anterior and posterior extremities, thick, forming a continuous more or less thin border or brim, the breadth of which is very considerable anteriorly. Tentacles from ten to twenty. Mouth completely ventral, at a considerable distance from the anterior extremity of the body. Round the edge of the brim there is a single row of numerous, commonly minute pedicels, often resembling protuberances or wart-like prominences; the foremost of those prominences belonging to the dorsal ambulacra, the rest to the ventral lateral ones. The odd ambulacrum generally with a double row of minute retractile pedicels; in one form naked. The dorsal surface naked (?) or with a few minute processes; or with a greater or smaller number of commonly minute but sometimes rather large, retractile or non-retractile processes, disposed in a single or a double row along each ambulacrum; or with a great many minute, completely retractile processes, scattered over the lateral interambulacra; or with fewer pairs of small, non-retractile processes anteriorly and a very large appendage, crossing the odd interambulacrum at a greater or smaller distance from the posterior extremity of the body. Calcareous deposits: spicula or four-armed, cruciform bodies. Calcareous ring incompletely developed, composed of five separate pieces (?), each consisting of a very fragile network.

The presence of pedicels along the three ambulacra of the ventral surface is to be regarded as a very valuable character for this family. A single genus, *Psycheotrephes*, forms an exception to this rule by having its odd ambulacrum naked. Considering this peculiarity, as well as the number of tentacles, it seems as if this genus may be considered as a transitional form connecting the family in question with the Elpidiidæ; consequently it remains to be decided to which of these two families it ought to be referred. The presence of the brim round the flat body has decided me in classing the animal in question in the family Psychropotidæ.

The remarkable large azygous appendage which gives the genera *Euphronides* and *Psychropotes* such a peculiar appearance is completely wanting in *Benthodytes*, which by its exterior seems to approach the representatives of the family Aspidochirotæ. On a closer examination it becomes evident that *Euphronides* and *Psychropotes* are closely allied, and more than once I have hesitated whether they ought to be considered as belonging to one and the same genus or not. The former is characterised by its very depressed body, which almost reminds one of gigantic Planarians; besides, its appendage is considerably smaller in comparison with the size of the body than is the case in *Psychropotes*, and is situated comparatively far from the posterior extremity of the body. The genus *Psychropotes* on the other hand has its body almost without exception rather high posteriorly and depressed anteriorly, and its gigantic appendage, being situated close to the posterior extremity of the body, bears a strong resemblance to a tail.

Tabular view of the Genera of the Family Psychropotidæ.

I. Odd ambulacrum naked, ... Gen. I. *Psycheotrephes.*
II. Odd ambulacrum with a double row of pedicels.
  A. Dorsal surface with a large appendage crossing the odd interambulacrum :
    a. Body very depressed; appendage comparatively short, situated anteriorly on the posterior third of the body, ... Gen. II. *Euphronides.*
    b. Body depressed anteriorly, increasing in height posteriorly; appendage very long, situated close to or not far from the posterior end of the body, ... Gen. III. *Psychropotes.*
  B. Dorsal surface without any large appendage, ... Gen. IV. *Benthodytes.*

Psycheotrephes,[1] n. gen.

Body very thin and depressed, with the brim round its anterior and posterior extremities rather broad. Mouth and anus ventral, at some distances from the ends of the body. Tentacles ten. Pedicels arranged in a single row round the edge of the brim; the odd ambulacrum naked. The dorsal surface with some minute processes.

Psycheotrephes exigua, n. sp. (Pl. VIII. fig. 8).

Body broadest anteriorly, about twice as long as its greatest breadth. Mouth and anus removed to a more or less considerable distance from the extremities of the body. Tentacles of equal size; their terminal part with numerous small papillæ round the edge. Pedicels round the edge of the brim minute, hardly discernible. The dorsal surface with a single pair of minute processes situated near its middle. Integument thin, with four-armed, cruciform calcareous deposits provided with several processes, one issuing from the centre and the other from the arms.

Colour in alcohol, light greyish violet. Length, about 25 mm. Breadth, about 12 mm.

Habitat.—Station 274. September 11, 1875. Lat. 7° 25′ S., long. 152° 15′ W. Depth, 2750 fathoms; bottom temperature, 0·9° C.; radiolarian ooze. One incomplete specimen.

The only individual which has been brought home is, unfortunately, so defective as to make a detailed examination impossible. The ventral surface is almost flat, while the dorsal is slightly convex, in consequence of which the shape of the body is extremely depressed. The brim is particularly broad at the anterior and posterior extremities of the body, while elsewhere it is only visible as a more or less distinct edge along each side of the ventral surface. In consequence of the considerable breadth of the brim anteriorly, that extremity of the body presents almost a circular, discoidal appearance with the mouth and tentacles in the centre. The broad, thin part of the brim behind the anus has almost the appearance of a fin, the rays of which are represented by fine canals, which connect the minute pedicels round the edge of the brim with the lateral ambulacra, and consequently penetrate the brim in its breadth. On account of the macerated condition of the perisoma, I have not been able to distinguish the anal aperture which has probably a ventral position, since no traces of it are visible on the dorsal surface. The papillæ of the terminal part of the tentacles, about twenty in number, resemble low ridges placed so as to lie from the edge towards the centre. As a portion of the ventral perisoma is torn off I am somewhat uncertain whether the odd ambulacrum is totally destitute of pedicels or not. The brim which surrounds the body carries on its edge a number of small scarcely distinguishable processes or pedicels, which by means of fine connecting canals are in communication with the ambulacral system; those canals are very obvious at both extremities of the body. Both of the dorsal processes are very minute, only one millimeter in length. The ventral surface seems to be almost destitute of calcareous bodies, while the dorsal one as well as the brim contain an abundance of slightly crowded four-armed, cruciform deposits (Pl. XXXV. fig. 12), the largest of which have their arms about 0·3 mm. long. The stems of the tentacles are strengthened by long, rather straight and large spicula, which lie transversely as well as longitudinally, the tentacles themselves thus becoming incapable of contraction (Pl. XLIV. fig. 1); the terminal part contains small spicula situated between the papilla, and like them directed from the periphery towards the centre.

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[1] Ψῦχος = cold.

Euphronides,[1] n. gen.

Body very thin and depressed, with the brim, especially round its anterior and posterior extremities, rather broad. Mouth and anus ventral, at some distances from the ends of the body. Tentacles eighteen. Pedicels arranged in a single row round the edge of the brim and in a double one along the odd ambulacrum. The dorsal surface with a few pairs of more or less minute processes, and with a large conical appendage crossing the odd interambulacrum at a considerable distance from its posterior extremity.

Euphronides depressa, n. sp. (Pl. XXVI.).

Body elongated, of almost equal breadth throughout, about thrice as long as broad. Tentacles almost equally large; their dilated terminal part with small retractile processes especially round the edge. The dorsal surface with four pairs of small processes arranged in its anterior half; the azygous large conical appendage situated at a distance of about 45 mm. from the posterior extremity of the body. Integument rough, thin, and transparent, with two sorts of calcareous deposits: unbranched more or less curved and spinose spicula; and numerous crowded four-armed, cruciform bodies of various dimensions, the arms of which are more or less curved and spinose.

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[1] Εὐφρονίδης the son of the Night.

Colour in alcohol, light reddish violet. Length, about 150 mm. Breadth, about 45 mm.

Habitat.—Station V. January 28, 1873. Lat. 35° 47′ N., long. 8° 23′ W. Depth, 1090 fathoms; bottom temperature, 3·1° C.; mud. One individual. Station 300. December 17, 1875. Lat. 33° 42′ S., long. 78° 18′ W. Depth, 1375 fathoms; bottom temperature, 1·5° C.; globigerina ooze. Two specimens.

The above diagnosis as well as the following description are taken from the individual, obtained at Station V. At the end of this description, an account will be added of the differences which distinguish the specimens from Station 300. The body is nearly of an equal breadth throughout or decreases slightly posteriorly, and has its extremities equally truncated and rounded; it is remarkable for its great thinness, the dorsal and ventral surfaces being only slightly convex. The flat brim is of considerable breadth round the anterior and posterior extremities of the body, its edge being undulated, and as if it were lobed anteriorly. The mouth and anus are situated on the ventral surface, the former about 15 mm. from its anterior extremity, and the latter 7 to 10 mm. from the posterior. The eighteen retractile tentacles attain about the same dimensions; their dilated terminal part is contracted, but presents some small processes, which are retracted and seem to be placed round the edge.

The processes of the dorsal surface present a conical form, and are not capable of being retracted; the three first pairs are situated anteriorly and are very small, only from 3 to 5 mm. long; the fourth pair, on the contrary, is considerably larger, its processes measuring up to 15 mm. in length and 9 to 10 mm. in diameter at the base. The first pair is situated at a distance of 35 to 40 mm. from the anterior extremity of the body, while the fourth is placed 55 to 60 mm. from that extremity. The large, azygous, lobe-like appendage has a transverse position, crossing the odd interambulacrum about 45 mm. in front of the posterior end of the body; it reaches 40 mm. in length and its breadth at the base, measuring 16 to 18 mm., is considerably greater than its thickness. The appendage has its top rounded and is penetrated by two wide canals, which are in connection with the dorsal ambulacra. The pedicels or rather processes, which shoot out from the margin of the foremost part of the brim belong doubtless to the dorsal ambulacra; from want of materials it has been impossible to make a closer examination of it, but in other forms, which are closely allied to this species, I have found that to be the case, and it probably should be common to the whole family. The pedicels of the odd ambulacrum are disposed in two alternating rows, thirty-one in the left and thirty-five in the right one, and are small and retractile; the foremost part of that ambulacrum is naked. The pedicels of the lateral ambulacra of the ventral surface are arranged in a single row round the edge of the brim, and are small, retractile, and of a conical form, and often hardly discernible. The perisoma is thin and more or less transparent. The deposits of the ventral integument (Pl. XXXV. fig. 6) are partly made up of more or less curved simple, slightly spinose, spicula about 0·2 mm. long, partly of three- or four-armed cruciform bodies with the arms slightly curved. On the dorsal surface, which is rather rough, four-armed bodies (Pl. XXXV. fig. 5), of variable shape, are found closely crowded together; their arms are more or less strongly arcuated and spinose, attain a length of 0·24 mm., and give off one or more processes; from the centre of these deposits a long spine runs out which gives the surface of the integument its roughness. The tentacles as well as the pedicels are strengthened by some slightly curved spinose spicula; the latter have no supporting terminal plates.

From want of material I have not been able to examine more closely the calcareous ring; but judging from what I have observed, its structure must be of great interest. The ring seems to be composed of five separate pieces resembling those in the family Elpidiidæ, but instead of a few rods running out in opposite directions, each piece consists in this species of an innumerable number of rods, which anastomose and form a kind of network which becomes most obvious towards the centre of the pieces. In the connective tissue, which surrounds the calcareous ring, a great number of deposits are found resembling in shape those of the ventral perisoma. The polian vesicle is about 20 mm. long. The madreporic canal, which seems to communicate with the exterior by a pore, contains a great number of deposits in the form of irregular unbranched or three- to four-armed, generally strongly spinose spicula. The ambulacral cavities of the small dorsal processes are very minute, while each of the two canals of the azygous appendage communicates with a large slightly curved and branched ambulacral cavity (Pl. XL. fig. 7). The cloaca being very wide fills up the posterior part of the peritoneal cavity, but it has no cæcal prolongation. The reproductive organ (Pl. XLVI. fig. 4), in the female, consists of two unbranched tubes about 32 mm. long, the posterior half of which is enlarged and sacciform, with many tuberculose prominences; the organ opens externally by a pore situated about 25 to 30 mm. behind the anterior extremity of the body.

The individuals from Station 300 are of gigantic size, the largest having a length of about 375 mm., and a breadth anteriorly of from 110 to 120 mm. The mouth is situated 45 to 50 mm. behind the anterior extremity of the body, and the anus about 20 mm. in front of the posterior extremity. The brim is very broad, especially round the anterior and posterior extremities. One of the specimens is of a light grey or somewhat violet colour, the other, on the contrary, is dark violet or rather black. The dorsal ambulacra carry anteriorly only six processes about 5 mm. long, which are indistinctly arranged in pairs. The large azygous appendage situated about 110 mm. from the posterior extremity of the body attains in its contracted state a length of 35 to 40 mm. and a breadth of 25 to 30 mm. at its base; probably it was considerably larger when fully extended. At the top of the appendage two small papillæ are distinguishable which are in communication with the two canals. The calcareous bodies, which are of the same shape as those in the specimen from Station V., seem to be more thinly scattered, especially on the ventral surface; their central process is not smooth, but usually provided with some spines and its top is generally bipartite. Only once have I found a minute wheel resembling those in *Lætmogone,* but this has probably been torn off from another animal, and has accidentally stuck to the rough integument of the individual under examination. The cloaca is far from being as large as in the individual from Station V. The reproductive organ is very large, attains a length of 125 mm., and resembles exactly in form the one above described; each of its posterior sacciform portions measures 55 to 60 mm. in length and 16 mm. in breadth, and is furnished with round tuberculose protuberances, thus having almost the shape of a spike of maize. The walls of the reproductive organ are strengthened, as is the case with the individual from Station V., by three- or four-armed deposits, with the arms spinose and slightly curved.

Psychropotes,[1] n. gen.

Body gradually decreasing in height forwards, its foremost part being rather thin and depressed; the brim rather broad anteriorly. Mouth and anus ventral, situated at greater or smaller distances from the extremities of the body. Tentacles ten to eighteen. Pedicels arranged in a single row round the brim of the body and in a double one along the odd ambulacrum. The dorsal surface with a smaller number of more or less minute processes, and with a large, broad and flat appendage, crossing the odd interambulacrum posteriorly.

Psychropotes longicauda, n. sp. (Pl. XXVII. fig. 1, and Pl. XXVIII.).

Body elongated, from four to five times as long as broad; its height decreasing gradually forwards and its breadth slightly narrowing backwards. Tentacles eighteen, almost equally large; their large discoidal terminal part with about sixteen small retractile processes round its edge. The dorsal surface with about five pairs of minute processes anteriorly; its very large, flat appendage situated near the posterior extremity of the body. Integument rather thick and soft, with four-armed, cruciform calcareous deposits, the arms of which are partly almost straight, slender, and provided with long spines, partly more or less curved, stronger and giving off shorter spines.

Colour in alcohol greyish violet, the ventral surface brownish. Length, about 140 to 150 mm. Breadth, about 55 mm.

Habitat.—Station 156. February 26, 1874. Lat. 62° 26′ S., long. 95° 44′ E. Depth, 1975 fathoms; diatom ooze. One specimen. Station 157. March 3, 1874. Lat. 53° 55′ S., long. 108° 35′ E. Depth, 1950 fathoms; diatom ooze. Two specimens. Station

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[1] Ψῦχος=cold.

298. November 17, 1875. Lat. 34° 7′ S., long. 73° 56′ W. Depth, 2225 fathoms; bottom temperature, 1·3° C.; grey mud. One specimen.

The body is 140 to 145 mm. long and reaches its greatest breadth, about 55 mm., anteriorly at the mouth or immediately behind it; it tapers slightly backwards. The height of the body decreases gradually forwards so that its anterior, nearly semi-circular end becomes rather thin and discoidal, and presents the aspect of a distinct head-part. The ventral surface is completely flat, while the dorsal, on the contrary, is convex. Another slightly smaller individual obtained at the same station (157) has its body very much swollen and almost ovate on account of the great quantity of Diatomaceæ, &c., which fills up the alimentary canal. The mouth is placed almost 25 mm. from the anterior extremity of the body, being thus situated in the centre of the anterior, flat, discoidal part of the under surface. The large anus is ventral, and is placed 10 mm. in front of the posterior extremity of the body. The odd ambulacrum is in connection with a number of small, round, retractile pedicels which are close set and disposed in an indistinctly alternating double row. The pedicels on the edge of the brim, which surrounds the body, are numerous and minute; excepting the anterior ones, which communicate with the dorsal ambulacra, all these pedicels belong to the ventral lateral ambulacra. The back is furnished with five pairs of very minute processes, of which the first is almost inconspicuous, and situated 45 mm. behind the anterior extremity of the body, while the last slightly larger pair is 75 mm. to 80 mm. distant from that extremity. The enormous dorsal appendage which arises 10 to 15 mm. from the posterior extremity of the body attains a length of 110 to 120 mm., and is almost of an equal breadth throughout, 30 to 35 mm., or slightly tapering towards the free end; it is flat, about 10 mm. thick, and forms a more or less distinct edge along each side. The rounded terminal part of the appendage is provided with two processes, of which the one is extended and digitiform, and measures 5 to 6 mm. in length. Those processes communicate with two wide canals, which penetrate the appendage in its length and open into the dorsal ambulacra (Pl. XXXVII. fig. 10). The eighteen tentacles are almost of equal size, or the ventral ones slightly smaller; their large discoidal convex end carries round the edge about sixteen small, simple, retractile processes.

The perisoma is rather thick, and contains deposits in the form of four-armed cruciform bodies of various dimensions. The deposits in the outer layer of the dorsal integument (Pl. XXXV. fig. 13) are closely crowded, with their arms rather arcuated, and supplied with a number of strong, short spines directed outwards; the largest deposits have their arms 0·4 mm. to 0·24 mm. long, while those of the smallest reach only 0·06 mm. in length. The calcareous bodies of the inner layer of the dorsal integument (Pl. XXXV. fig. 14) are remarkable for having their arms very slender, almost straight, and giving off very long and narrow spines in all directions. The deposits of the ventral surface (Pl. XXXV. fig. 16) do not lie so close set, and are commonly smaller and of a very irregular shape, being all more or less strongly spinose; the largest ones, having their arms 0·24 mm. to 0·16 mm. in length, are much scattered in comparison with the smaller ones, the arms of which only attain to 0·08 mm. In the ventral perisoma I have found, besides the four-armed form, three-armed bodies as well as simple arcuate spicula. The pedicels (Pl. XXXV. fig. 17) are strengthened only by a few spinose spicula, and the tentacles (Pl. XXXV. fig. 15) by a number of short, thick, more or less curved ones which are very poor in spines.

The calcareous ring appears to consist of a very fragile network, which, as far as I can determine, does not form a continuous ring, but is made up of five separate pieces; from want of materials I have not been able to make a closer examination. The polian vesicle is narrow, cylindrical, and attains a length of 45 mm. The madreporic canal opens externally by three pores situated close in front of the genital pore; it is supported by a great number of closely-crowded deposits resembling those of the inner layer of the integument though of a rather more irregular shape. The cloaca is considerable, without any cæcal prolongation. The reproductive organ consists of two very wide tubes, 35 to 40 mm. long, one on each side of the dorsal mesentery; each tube carries in its posterior half a small number of large, oval cæcal sacks, about 5 mm. long, which are either simple or show a tendency to dichotomous branching. The genital pore is situated 45 mm. in front of the posterior extremity of the body.

The specimen dredged at Station 156, from a depth of 1975 fathoms, seems to bear the strongest resemblance to this species. The length of its body is 80 to 85 mm., and the dorsal appendage, which measures 80 mm., does not terminate in the same manner as in the typical form, but tapers to a point which communicates with the left of the two canals; the right canal terminates inconspicuously near the point just mentioned. The terminal part of the appendages appears in general to change its form in the very same species. The back has only four pairs of minute processes. The integument is very rough.

Concerning the specimen from Station 298 I feel somewhat uncertain whether it ought to be considered as belonging to this species or not. Its body attains the gigantic length of 260 mm. and the dorsal appendage measures 150 mm. The calcareous substance of the integument is completely dissolved. Each of the dorsal ambulacra possesses only a couple of minute processes.

Psychropotes longicauda, var. *monstrosa*, n. (Pl. XXIX. fig. 2, and Pl. XXX.).

Habitat.—Station 157. March 3, 1874. Lat. 53° 55′ S., long. 108° 35′ E. Depth, 1950 fathoms; diatom ooze. One specimen.

The general appearance of the body closely resembles that of *Psychropotes longicauda* wherefore I only intend to point out the insignificant characters which distinguish them from one another. The animal, of a dirty brown colour, reaches an enormous size, its length being about 250 mm., and its greatest breadth about 95 mm.; the body narrows slightly backwards, so that the breadth at its rounded posterior extremity is about 60 mm. As the height of the body decreases gradually forwards, the anterior broadest portion becomes flat and almost discoidal. The left ambulacrum of the dorsal surface carries only five very minute processes, while the right one is provided with seven; all of them are usually so small that they are scarcely distinguishable. The large dorsal appendage attains a length of 110 mm., being thus comparatively shorter than in *Psychropotes longicauda*. The brim, which is of considerable breadth, especially round the anterior extremity of the body, has the appearance of being lobed in consequence of the great number of large pedicels or processes which proceed from its edge. These pedicels communicate with longer or shorter, very wide canals, which in their turn open into the ambulacral vessels; the first eighteen pedicels or rather processes are connected with the dorsal ambulacra, while the rest of them belongs to the ventral-lateral ambulacra (Pl. XXXIX. fig. 1).

The calcareous bodies bear the strongest resemblance to those of the species just mentioned, though they seem to be more dispersed especially on the ventral surface; besides, I have not been able to observe the deposits of the inner layer of the integument, and if such are present they must be extremely thinly scattered. On the contrary, I have found in the connective tissue of the integument abundance of pigment of a yellowish-brown colour.

The cæcal sacks which constitute the reproductive organ are large, more or less distinctly rounded and about 12 mm. in diameter, being thus several times larger than in *Psychropotes longicauda.*

The above summary description proves that this form is closely allied to the preceding one; the only differences to be found are the size of the body, the proportion between the length of the body and that of the dorsal appendage, the number of dorsal processes, and the presence or absence of deposits in the inner layer of the integument.

Psychropotes longicauda, var. *fusco-purpurea*, n. (Pl. XXIX. fig. 1).

Habitat.—Station 157. March 3, 1874. Lat. 53° 55′ S., long. 108° 35′ E. Depth, 1950 fathoms; diatom ooze. Two specimens.

The largest of the two individuals which were brought home measures 200 mm. in length and 77 mm. in breadth. This variety differs from the preceding forms by the following characteristics:—(1.) The colour is dark violet, almost black, with darker bands along the dorsal ambulacra. (2.) The dorsal appendage, 65 mm. long in the largest specimen, is smaller in proportion to the size of the body, and its obtuse end wants the digitiform processes; its left canal decreases more perceptibly upwards than the right one, and does not reach the top of the appendage. (3.) The minute processes of the dorsal surface are arranged in four pairs. (4.) The deposits do not present so great a variation in dimensions as in the preceding forms; their four slightly curved and spinose arms, measuring in length about 0·1 mm., carry a couple of larger outwardly directed spines, and the centre, where the arms are united, gives off an obtuse, short process (Pl. XXXV. fig. 11).

Psychropotes loveni, n. sp. (Pl. XXVII. figs. 2–4).

Body depressed, decreasing in height towards each extremity, of almost equal breadth throughout, from twice to twice and a half as long as broad. Tentacles ten, almost equally large; their terminal part contracted and destitute of visible processes. The dorsal surface with a pair of minute conical processes placed a little in front of its middle; its hindmost part prolonged into the large flat transverse appendage, the broad truncated top of which is provided with two short processes. Integument thin and transparent, with numerous cruciform calcareous deposits resembling those of the preceding species.

Colour in alcohol light violet; pedicels, especially those of the odd ambulacrum, tentacles, and the oral disk darker, almost blackish violet. Length, about 45 to 50 mm. Breadth, about 15 to 20 mm.

Habitat.—Station 146. December 29, 1873. Lat. 46° 46′ S., long. 45° 31′ E. Depth, 1375 fathoms; bottom temperature, 1·5° C.; globigerina ooze. One individual.

The ventral surface is flat and the dorsal one slightly convex, so that the body is very depressed; the height decreases backwards but especially forwards. The terminal part of the tentacles is contracted, so that no processes are distinguishable. The mouth and anus are situated on the ventral surface, the former 8 to 10 mm. behind its anterior extremity and the latter immediately in front of its posterior end. The pedicels are minute, and their arrangement resembles that of the preceding species. The two small conical processes in the middle of the back attain a length of only 1 to 2 mm. The large, thin dorsal appendage is at its base of the same breadth as the body itself, and its broad truncated end gives off on each side a short conical process.

The rather thin and transparent integument is supported by numerous calcareous deposits (Pl. XXXV. fig. 2), of about the same shape as those of *Psychropotes longicauda;* the arms of those deposits are usually provided with only one very long process and a few minute ones, and their length varies greatly, from 0·26 mm. to much less. The four-armed deposits of the inner layer of the perisoma (Pl. XXXV. fig. 3) are partly very slender and furnished with long spines, and partly almost smooth, and only supplied with a single central process. The deposits of the ventral surface (Pl. XXXV. fig. 1) give off a small central process, and their more or less curved arms carry some minute spines at their ends. The pedicels are almost destitute of spicula or possess only a few, while the tentacles are strengthened by many larger and smaller ones which are unbranched.

Psychropotes semperiana, n. sp.

Body elongated, about four times longer than broad. Tentacles sixteen, of nearly equal size, their large discoidal terminal part with small retractile processes especially round its edge. The dorsal surface with three pairs of small processes; its large broad and thin appendage situated 30 to 40 mm. from the posterior extremity of the body. Integument with numerous crowded calcareous deposits of almost the same cruciform shape as those of the preceding species.

Colour in alcohol, dark violet; the ventral surface darker; tentacles light. Length, about 130 to 140 mm. Breadth, about 35 mm.

Habitat.—Station 101. August 19, 1873. Lat. 5° 48′ N., long. 14° 20′ W. Depth, 2500 fathoms; bottom temperature, 1·7° C.; mud. One rather incomplete specimen. Station 133. October 11, 1873. Lat. 35° 41′ S., long. 20° 55′ W. Depth, 1900 fathoms; bottom temperature, 1·3° C.; globigerina ooze. One specimen.

As far as regards the shape of the body this species seems to bear the strongest resemblance to the preceding ones which are characterised by having a large dorsal azygous appendage. As the specimens are rather incomplete, a more detailed examination is impossible. The mouth is as usually placed on the ventral surface, about 15 mm. behind its anterior extremity, and the anus is situated from 10 to 12 mm. in front of the posterior end. The sixteen tentacles are almost of an equal size, the ventral ones slightly smaller, and their large, discoidal, terminal part is furnished with some minute retractile processes which are present especially round the edge. Each of the dorsal ambulacra sends out three minute processes, 3 mm. long, which are arranged in pairs, the first of which is situated about 40 mm., the second about 45 mm., and the third about 70 mm. from the anterior extremity of the body. The large transverse dorsal appendage has its free end rounded, and arises 30 to 40 mm. in front of the posterior extremity of the body, thus being situated at a greater distance from that extremity than is the case in other forms of this genus. The deposits (Pl. XXXIV. fig. 10) of the integument are rather irregular and are composed of four, rarely three or five, arms; they vary considerably in size, some having their arms 0·16 mm. long, others only 0·06 mm. The top of the central process of those deposits is sometimes simple, sometimes bipartite or tripartite. The deposits of the ventral surface (Pl. XXXIV. fig. 11) consist of simple spicula or irregular three- or four-armed spinose bodies. The tentacles are supported by numerous, small, simple, curved or straight spinose spicula.

The polian vesicle has a cylindrical form and reaches a length of 25 to 30 mm. The madreporic canal opens externally by three pores, far distant from one another, and situated a little in front of the genital aperture, which lies at a distance of 35 mm. behind the anterior extremity of the body. The madreporic canal is strengthened by numerous three- or four-armed spinose deposits, resembling those of the integument though more irregular. The reproductive organ consists of two wide tubes, 35 to 40 mm. long, the posterior half of which is strongly dilated, sacciform, with a diameter of about 12 mm., and provided with a great many tuberculose protuberances or rather cæca; consequently the organ bears a strong resemblance to that of *Euphronides depressa.*

Benthodytes,[1] n. gen.

Body more or less depressed, with the anterior part of its brim rather large. Mouth ventral, at a greater distance from the foremost extremity of the body. Anus posterior, dorsal, usually almost terminal. Tentacles twelve (?) to twenty. Pedicels arranged in a single row round the brim of the body and in a double one along the odd ambulacrum. The dorsal surface seldom naked, commonly with a greater or smaller number of retractile or non-retractile, more or less inconsiderable processes, arranged in a single row all along each ambulacrum or in an irregular double row, or scattered over the lateral interambulacra.

Benthodytes papillifera, n. sp.

Body elongated, of an almost oval form, about thrice as long as broad. Tentacles twenty; some of the ventral ones slightly smaller than the others; their dilated terminal part with small retractile processes round the edge. The dorsal surface destitute of processes (?). Integument rather thick and soft with numerous conical papillæ, crowded all over the back; calcareous deposits in the form of more or less straight, spinose or almost smooth spicula.

Colour in alcohol blackish violet on the ventral surface, and rather light violet on the back; the thin brim surrounding the body is striated by lighter and darker bands. Length, about 150 mm. Breadth, about 50 mm.

Habitat.—Station 184. August 29, 1874. Lat. 12° 8′ S., long. 145° 10′ E. Depth, 1400 fathoms.; bottom temperature, 1·8° C.; grey ooze. Four very incomplete and macerated specimens. Station 300. December 17, 1875. Lat. 33° 42′ S., long. 78° 18′ W. Depth, 1375 fathoms; bottom temperature, 1·5° C.; globigerina ooze. Five specimens. Station 271. September 6, 1875. Lat. 0° 33′ S., long 151° 34′ W. Depth, 2425 fathoms, bottom temperature, 1·0° C.; globigerina ooze. Four rather macerated individuals.

The body is more depressed than in the preceding genus and its brim is rather broad. The tentacles, pedicels, &c., closely resemble those of *Benthodytes sanguinolenta.* The wide canals which belong to the lateral pedicels are plainly to be seen through the brim. A transverse row of small papilla-like prominences is present on the ventral surface immediately behind the crown of tentacles. The back seems to be destitute of processes, but if there are any which have escaped my notice, they ought to be situated in its most anterior part. The whole dorsal surface is, on the contrary, covered with closely crowded, small, conical papillæ, which do not communicate with the ambulacral system, but must be considered as prominences of the integument. Each papilla appears to contain one or more calcareous spicula (Pl. XXXIV. fig. 14), of which one always shoots out beyond the top; those spicula are sometimes spinose, sometimes almost smooth, and attain a length of about 0·44 mm. The pedicels of the odd ambulacrum are strengthened by more curved and transversely directed spicula. No other forms of deposit have been observed.

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[1] Βένθος = depths of the sea.

The calcareous ring consists of a fragile network, without any distinct radial and interradial pieces. The madreporic canal does not communicate with the exterior, but terminates in a large, almost globular, madreporic plate or tubercle, made up of a strong network, and which is intimately attached to the inside of the perisoma close to the reproductive pore. The walls of the madreporic canal are supported by rather straight and spinose spicula. The reproductive organ is composed of two smaller fascicles 35 mm. long, each made up of small bundles of dichotomous, elongated, minute cæca; the organ opens 20 to 30 mm. behind the anterior extremity of the body.

The specimens obtained at Station 184 are very macerated and in such an incomplete state as to render examination impossible. In one example I thought I could distinguish some small dorsal processes anteriorly, and in another specimen there were only nineteen tentacles to be found. The four individuals dredged at Station 271 do not quite agree with the typical forms; their body is of a sea-green colour, which inclines to red on the ventral surface; the inside of the body-wall is, on the contrary, of a dark reddish violet; the shape of their body is broader and considerably higher than in the typical forms; all deposits are destroyed.

Benthodytes typica, n. sp. (Pl. XXVII. fig. 7).

Body more or less depressed, oval, from once and a half to twice as long as broad; its brim very broad. Tentacles twenty, retractile; some of them being slightly smaller than the others; their dilated terminal part provided with small retractile processes round its edge. Each of the dorsal ambulacra with a few, about eight, very minute, completely retractile processes. Integument rather thick, soft, and transparent, with scattered, more or less curved, unbranched, and spinose calcareous spicula.

Colour in alcohol light bluish, the ventral surface blood-red or purple; the five yellow muscular bands, the deep red ambulacral vessels, and the purple circular muscular layer are conspicuous through the integument; the canals, which belong to the minute pedicels situated round the brim, present the aspect of deep reddish bands which radiate towards the circumference of the body; the ends of the tentacles are yellowish-brown. Length, about 80 mm. Breadth, about 45 mm.

Habitat.—Station V. January 28, 1873. Lat. 35° 47′ N., long. 8° 23′ W. Depth, 1090 fathoms; bottom temperature, 3·1° C.; mud. Numerous more or less macerated individuals.

The body is of an oval form decreasing evenly towards each of its rounded extremities. As will be seen from the above measurements, its greatest breadth almost approaches half of its length, but from the drawings which have been taken of fresh animals dredged during the Challenger expedition, the breadth must have been much greater. When fully extended the body appears to be rather depressed, and its broad surrounding brim very thin, especially towards its edge. Here and there a tentacle is found slightly smaller than the others; the terminal part itself as well as its processes are covered with some minute prominences. The pedicels of the odd ambulacrum, about sixty in number, are minute and closely crowded together. The brim, which in some more extended individuals is even as broad as the body itself, is penetrated by a great number of closely-lying canals, which connect the ambulacral system with the minute conical pedicels round the edge. Those canals are plainly visible through the integument in consequence of their walls being of a dark purple colour. The dorsal processes (Pl. XLIV. fig. 8) are very minute and completely retractile; their number does not seem to exceed eight along each ambulacrum. When the body is contracted the thick dorsal perisoma forms large rounded lobes separated from one another by funnel-shaped hollows at the bottom of which the processes are to be found.

The calcareous deposits (Pl. XXXV. fig. 4) of the integument are rather scattered and consist of more or less curved unbranched and spinose spicula. The tentacles, processes, and pedicels contain also spicula of about the same shape.

The polian vesicle attains a length of from 20 to 25 mm. The madreporic canal opens externally immediately in front of the genital aperture; its walls are strengthened by a calcareous network, and by spicula (Pl. XXXVIII. fig. 5). The very narrow part of that canal which pierces the body-wall is destitute of deposits excepting its uppermost part close to the "pore," which is surrounded by a minute network. The cloaca is of considerable size. The calcareous ring seems to consist of a very fragile irregular network, the true form of which I have not been able to study. The reproductive organ consists of two small, thin fascicles, each composed of a few larger and smaller sometimes rather long cæca; the organ opens from10 to 15 mm. behind the anterior extremity of the body.

Benthodytes sanguinolenta, n. sp. (Pl. XXIII.).

Body elongated, more or less cylindrical, six to seven times longer than broad. Tentacles eighteen, with their dilated terminal part provided with small retractile digitiform processes round its edge. The dorsal surface with a great many very minute, completely retractile processes, scattered over the lateral interambulacra; the odd interambulacrum naked or with a few such processes. Integument thin and pliable; its calcareous deposits dissolved.

Colour in alcohol red, inclining to violet; the back lighter excepting its processes, which are of a darker colour. Length of the largest specimen, about 340 mm. Breadth, about 50 mm.

Habitat.—Station 298. November 17, 1875. Lat. 34° 7′ S., long 73° 56′ W. Depth, 2225 fathoms; bottom temperature, 1·3° C.; grey mud. Three specimens.

Station 295. November 5, 1875. Lat. 38° 7′ S., long. 94° 4′ W. Depth, 1500 fathoms; bottom temperature, 1·4° C.; red clay. One specimen.

The body has an almost cylindrical form or tapers slightly backwards, and its foremost part is very much depressed and thin. The ventral surface is flat or inconsiderably convex, while the dorsal one is strongly so. The oral aperture is 25 to 30 mm. distant from the anterior extremity of the body. The ventral tentacles are a little smaller than the others. As is usual in this family the pedicels or processes round the sides of the body have a conical form, and reach greater dimensions than the minute cylindrical ones, which belong to the odd ambulacrum. The pedicels round the body may be estimated at about one hundred and forty or two hundred, while the number of those on the odd ambulacrum seems to be from seventy to a hundred. Immediately behind the ventral tentacles a transverse row of small papilla-like prominences is to be seen. The dorsal surface possesses a great many minute completely retractile prominences or processes, which closely resemble pedicels, and are scattered along the ambulacra as well as on the lateral interambulacra, while few or none are to be found on the odd interambulacrum (Pl. XLII. fig. 6). These processes are visible to the naked eye as small dark specks. The integument is rather thin and soft, and as its calcareous deposits are completely dissolved, I have not been able to distinguish their form.

The Polian vesicle presents a cylindrical form, and reaches a length of 35 mm. (Pl. XL. fig. 5). The madreporic canal does not seem to open exteriorly, but terminates in a madreporic plate or tubercle, which is attached to the inside of the body-wall, consequently the ambulacral system communicates with the peritoneal cavity; once I thought I could observe that the madreporic canal gave off a fine branch piercing the perisoma, but I am by no means sure of it. The calcareous matter being entirely dissolved, no traces of deposits are to be found in the walls of the water-vascular system. The cloaca is not very greatly developed. The intestine gives off a large, cæcal prolongation or diverticulum (Pl. XL. fig. 4), 15 mm. long, which communicates with the interior of the alimentary canal, and is situated at a distance of about 170 mm. from the anal aperture. All the individuals obtained are males; their reproductive organ is often very long, about 180 mm., and consists of two fascicles, each made up of a long wide tube which carries numerous small bundles of oval or round, more or less inconsiderable, cæca. The common duct of the genital organ opens by a pore situated about 50 mm. behind the anterior extremity of the body.

Benthodytes sanguinolenta, var. *marginata*, n. (Pl. XXV. fig. 2).

Habitat.—Station 158. March 7, 1874. Lat. 50° 1′ S., long. 123° 4′ E. Depth, 1800 fathoms; bottom temperature, 0·3° C.; globigerina ooze. One specimen. Station 160. March 13, 1874. Lat. 42° 42′ S., long. 134° 10′ E. Depth, 2600 fathoms; bottom temperature 0·2° C; red clay. Four specimens.

This animal bears so strong a resemblance to *Benthodytes sanguinolenta* that I am undecided as to whether I am authorised in referring it to a variety or not. The characteristics which distinguish them from one another seem to be of very little importance. The specimens at my disposal are, however, in such a state of maceration and incompleteness as to make a closer examination impossible, all traces of calcareous matter being completely dissolved. The largest specimen reaches a length of 260 to 270 mm. and a breadth of about 40 to 45 mm. In some individuals the brim round the body is much more considerable and distinct than in others. The head-part of the body is rather depressed. The large discoidal terminal part of the tentacles as well as its retractile processes are covered with small papillæ; three to four of the ventral tentacles are considerably smaller than the others. The odd ambulacrum is provided with about a hundred small cylindrical pedicels; its foremost and hindmost parts however have none. The papilla-like prominences or pedicels round the brim are minute, and estimated in number at about two hundred in all; the canals which connect them with the ambulacral system are wide, and are plainly visible in consequence of their walls being full of a dark pigment (Pl. XL. fig. 8). The dorsal ambulacra give off a great abundance of longer and shorter canals which run into a corresponding number of minute thread-like completely retractile processes (Pl. XL. fig. 6); these processes are scattered all over the lateral interambulacra and also over those parts of the odd interambulacrum which border on both of the dorsal ambulacra. The integument is very much macerated, and presents only very indistinct traces of four-armed deposits, of which the calcareous substances have been almost entirely dissolved. The pedicels and tentacles are strengthened by small transverse spicula. The colour is light grey inclining to blue or violet; the tentacles as well as the integument surrounding the mouth and along the middle of the ventral surface are of a dark violet almost black. All the interior organs closely resemble those of *Benthodytes sanguinolenta*, excepting the reproductive organ, which is smaller, from 110 to 120 mm. in length in the largest specimens, and much thinner; each of its fascicles is composed of a long, wide canal carrying a small number of thin bundles of cæca, which are long and thread-like in the females and oval and much shorter in the males.

Benthodytes abyssicola, n. sp.

Body elongated, almost cylindrical, six to seven times as long as broad. Tentacles fifteen, with their large discoidal terminal part provided with about twelve digitiform retractile processes round its edge. Each of the dorsal ambulacra with about eight to ten minute scattered processes. Integument rather thin and pliable, with scattered, cruciform calcareous deposits, the calcareous substances of which are completely dissolved.

Colour in alcohol blackish- or brownish-violet, here and there considerably lighter; in some individuals the coloration is uniform, light dirty violet. Length, about 280 mm. Breadth, about 40 mm.

Habitat.—Station 298. November 17, 1875. Lat. 34° 7′ S., long. 73° 56′ W. Depth, 2225 fathoms; bottom temperature, 1·3° C.; grey mud. Several specimens.

Among the specimens, which have been dredged at the above-mentioned station only a single one is completely extended and presents the shape and dimensions which are noted in the diagnosis; all the other individuals are more or less contracted, consequently the form of their body deviates in some degree from that above described. The ventral surface is nearly flat or slightly convex, and more or less like a sole, while the dorsal one is strongly convex; forwards, but especially backwards, the body is depressed, its hindmost extremity being thus almost flat. The mouth is completely ventral, while the anal aperture is dorsal, situated close above and in front of the hindmost pedicels. The fifteen tentacles are capable of being entirely drawn within the body, and their discoidal end is provided with about twelve small, retractile, digitiform processes which are arranged round its edge. The minute cylindrical pedicels of the odd ambulacrum, from fifty to sixty in number in the largest specimen, are not to be found in the foremost part of the ventral surface. The numerous pedicels round the more or less considerable brim of the body are of a conical form, retractile, and mostly visible as small tubercles; they are much larger than those belonging to the odd ambulacrum. The very thin hindmost portion of the body presents almost the aspect of a fin, on account of the small pedicels round its edge and their wide canals, which communicate with the lateral ambulacra and penetrate it. Immediately behind the ventral tentacles some small papilla-like projections are to be observed, which are indistinctly disposed in a transverse row. The back is provided with minute conical processes, from eight to ten in number, which are scattered along each of its ambulacra, and are often scarcely distinguishable.

The body-wall is thin and soft, and contains scattered cruciform calcareous deposits, the arms of which seem to be more or less spinose, and attain a length of about 0·5 mm. (Pl. XXXVI. fig. 26). Unfortunately, the calcareous substances are mostly dissolved, consequently the true shape of the deposit is scarcely discernible. Here and there some minute round or elliptical grains are to be found within the integument, but their presence ought probably to be ascribed to some foreign matters (Pl. XXXVI. fig. 27).

The calcareous ring is almost totally dissolved, wherefore it has not been possible to examine it. The Polian vesicle is cylindrical, and measures from 35 to 40 mm. The madreporic canal opens exteriorly, partly by a single pore (Pl. XXXVIII. fig. 2), partly by several (Pl. XXXVIII. figs. 1 and 3), which are thus crowded on the obtuse top of a small papilla, situated somewhat in front of the genital pore; when there is only one pore, this seems to be placed side by side with the genital aperture. The madreporic canal is strengthened by a great number of more or less regular and spinose cruciform deposits (Pl. XXXVIII. fig. 4) resembling those of the perisoma. The reproductive-organ (Pl. XLVI. figs. 9–10) consists of two fascicles about 70 mm. long, and its common efferent duct opens by a pore situated about 45 mm. behind the anterior extremity of the body. In the male the fascicles are very thick and composed of numerous small, oblong dichotomous cæca. The female fascicles, on the contrary, are very thin, each made up of about three branches, which carry one or two unusually large, short and thick, dichotomous cæcal sacs.

Benthodytes sordida, n. sp. (Pl. XXIV.).

Body elongated, slightly tapering towards the extremities, from three and a half to five times as long as broad. Tentacles fifteen; some of the ventral ones smaller than the others; their large discoidal terminal part with numerous retractile processes. Each of the dorsal ambulacra with three rather large conical processes arranged in pairs, and with some smaller ones. Integument soft and rather thin; the calcareous deposits completely dissolved.

Colour in alcohol, dark greyish-brown inclining to blue or violet; the back slightly lighter. Length, about 280 mm. Breadth, about 60–80 mm.

Habitat.—Station 156. February 26, 1874. Lat. 62° 26′ S., long. 95° 44′ E. Depth, 1975 fathoms; diatom ooze. One individual. Station 157. March 3, 1874. Lat. 53° 55′ S., long. 108° 35′ E. Depth, 1950 fathoms; diatom ooze. Four incomplete specimens. Station 158. March 7, 1874. Lat. 50° 1′ S., long. 123° 4′ E. Depth, 1800 fathoms; bottom temperature, 0·3° C.; globigerina ooze. One specimen. Station 298. November 17, 1875. Lat. 34° 7′ S., long. 73° 56′ W. Depth, 2225 fathoms; bottom temperature, 1·3° C.; grey mud. One specimen.

The elongated body appears to reach its greatest width at the middle, and becomes gradually depressed anteriorly and posteriorly. The dorsal surface is strongly convex, while the ventral is slightly so or almost flat. Anteriorly the width of the body decreases, so as to form a narrower neck-like portion immediately behind the considerably broader round and flat head-part. The mouth is situated on the ventral surface in the centre of the large discoidal head. Among the fifteen tentacles some of the ventral ones are slightly smaller; their large, discoidal ends have a diameter of up to 12 mm. and carry numerous retractile processes covered with some small papillæ. The pedicels round the body, of which the foremost ones belong to the dorsal ambulacra, while all the others communicate with the lateral ventral ambulacra, present the aspect of larger and smaller protuberances round the edge of the brim. The pedicels of the odd ambulacrum resemble minute round warts with a diameter of about 3 mm. The three pairs of larger dorsal processes are thus arranged: the first one at the first fourth of the body, the second in its middle, and the third at the third fourth of the body. These processes attain a length of about 15 mm., and the circumference at their base is rather considerable. Besides these, some minute processes are scattered over both of the ambulacra, the number of which I have not been able to determine.

The calcareous deposits of the rather firm perisoma are completely dissolved; however, I believe their shape to resemble that of the deposits of *Benthodytes abyssicola*, to which this species is closely allied.

The Polian vesicle is sacciform, about 60 mm. long. The madreporic canal communicates with the surrounding medium by pores, which lie close together about 60 mm. behind the anterior extremity of the body; its walls are strengthened by numerous deposits of the same form as those in the above-mentioned species. The cloaca is elongated and attached to the inside of the body-wall by means of numerous threads and bands. The reproductive organ of the female bears a strong resemblance to that of *Benthodytes abyssicola*, though its cæca attain uncommonly great dimensions, their length being from 15 to 20 mm. and their diameter about 8 mm. Each of the two fascicles which constitute the organ is composed of a tube which carries throughout the whole of its length from eight to twelve short branches, each terminating in one or two enormous dichotomous cæca; sometimes the branches are so short that the cæca seem to proceed directly from the tubes. The aperture of the genital organ lies close to the pores of the madreporic canal.

Thus, this form differs from the closely-allied *Benthodytes abyssicola* by the very broad and thin brim round its head, by the large size and the arrangement of its dorsal processes, &c. The individual dredged at Station 158 is in such a state of contraction as to make a closer knowledge of its outer form impossible; its colour is of a blackish-violet.

The specimens which are brought home from Station 157 are males, consequently their reproductive organ differs in some degree from the one above described; each of their fascicles consists of a great many bundles of numerous small, elongated, dichotomous cæca. The colour is blackish-violet. Besides the larger processes above mentioned, the dorsal ambulacra carry five pairs of smaller ones placed in the anterior part of the back.

Benthodytes mamillifera, n. sp. (Pl. XXV. fig. 1).

Body elongated, of almost equal breadth, from four to five times as long as broad. Tentacles fifteen; some of the ventral ones smaller than the others; their large discoidal terminal part with small tuberous prominences round its edge. The dorsal surface with numerous, short, non-retractile conical processes, disposed in a more or less distinctly alternating double row all along each of its ambulacra. Integument rather thick; its calcareous deposits fully dissolved.

Colour in alcohol violet, more or less inclining to red or blue; the back lighter, with its processes almost white; the ventral surface dark violet; tentacles lighter, with brownish terminal parts. Length, about 235 mm. Breadth, about 50 mm.

Habitat.—Station 295. November 5, 1875. Lat. 38° 7′ S., long 94° 4′ W. Depth, 1500 fathoms; bottom temperature, 1·4° C.; red clay. One specimen. Station 298. November 17, 1875. Lat. 34° 7′ S., long. 73° 56′ W. Depth, 2225 fathoms; bottom temperature, 1·3° C.; grey mud. One specimen. Station 299. December 14, 1875. Lat. 33° 31′ S., long 74° 43′ W. Depth, 2160 fathoms; bottom temperature, 1·1° C.; grey mud. Eight specimens.

The body is rather depressed, especially at the ends. In some individuals only fourteen tentacles are to be found; the fifteenth is probably torn off, which must be ascribed to the macerated and incomplete state of the preserved specimens. Some of the ventral tentacles are smaller than the others; the large discoidal terminal parts are very much contracted and present small protuberances round their edges. The pedicels of the odd ambulacrum are minute, and when retracted scarcely discernible exteriorly. The pedicels round the brim are very numerous, and present the aspect of small round or conical prominences. Each of the dorsal ambulacra is provided with about forty small conical processes which are disposed in a more or less distinctly alternate longitudinal double row; the circumference of these processes at their base is pretty large, but they do not reach more than from 5 to 6 mm. in length.

The calcareous substances of the deposits of the somewhat thick perisoma are totally dissolved; in the tentacles alone some traces of spicula have been discovered. The strongly developed connective tissue is full of a reddish pigment, which is partly aggregated, partly arranged in fine and long branched threads, which in some places form clews and bear a strong resemblance to fine vessels.

The elongated Polian vesicle attains a length of from 30 to 35 mm. The hindmost portion of the intestine is dilated into a cloaca, which, however, in accordance with the state of most of the forms of this genus, does not send out any cæcal prolongation. The madreporic canal seems to open exteriorly, though I sometimes feel uncertain concerning it. The reproductive organ is composed of two small fascicles 35 mm. long, each made up of a number of bundles of elongated dichotomous cæca; its aperture is situated about 25 mm. distant from the anterior extremity of the body.

The individuals dredged at Stations 295 and 298 are of a considerably lighter colour, and the one which has been brought home from the latter station being a female, has the cæca of the genital organ more or less globular.

Benthodytes selenkiana, n. sp. (Pl. XXVII. figs. 5, 6).

Body depressed, of almost equal breadth, about twice to thrice as long as broad. Tentacles twelve (?), retracted within the mouth. The dorsal surface with small conical, not retractile processes, disposed in a more or less irregular double row all along each of its ambulacra. Integument rather thick and leathery, with four-armed deposits, the calcareous substances of which are fully dissolved.

Colour in alcohol, dirty brown. Length, about 125 mm. Breadth, about 45 mm.

Habitat.—Station 274. September 11, 1875. Lat. 7° 25′ S., long. 152° 15′ W. Depth, 2750 fathoms; bottom temperature, 0·9° C.; radiolarian ooze. One individual.

The mouth is situated 20 mm. behind the anterior extremity of the body. The pedicels of the odd ambulacrum are from thirty to forty in number. The dorsal processes, from 3 to 4 mm. long, do not seem capable of being retracted, and are disposed twenty-three along the left ambulacrum, and about twenty-one along the right one.

The calcareous deposits of the integument are entirely dissolved, but to judge from the remaining membranes which surround them, they ought evidently to have been four- or three-armed bodies. The madreporic canal seems to pierce the body-wall. The Polian vesicle is single. The cloaca is rather considerable. The reproductive organ, about 30 mm. long, consists of two fascicles of very small, slightly elongated dichotomous cæca; its aperture is situated from 28 to 30 mm. behind the anterior extremity of the body.

Tabular view of the Species of the Genus *Benthodytes*.

I. Tentacles twenty.	
A. Integument with numerous crowded papillæ on the back; no dorsal processes (?), ...	*Benthodytes papillifera.*
B. Integument without papillæ; about eight minute processes arranged along each of the dorsal ambulacra, ...	*Benthodytes typica.*
II. Tentacles eighteen; dorsal processes numerous, minute and retractile, scattered over the lateral interambulacra, ...	*Benthodytes sanguinolenta.*
III. Tentacles fifteen.	
A. Dorsal processes arranged in a single row along each ambulacrum—	
a. All dorsal processes minute, ...	*Benthodytes abyssicola.*
b. Three pairs of the dorsal processes comparatively large, .	*Benthodytes sordida.*
B. Dorsal processes arranged in an irregular double row along each ambulacrum, -	*Benthodytes mamillifera.*
IV. Tentacles twelve (?); dorsal processes arranged in an irregular double row along each ambulacrum, ...	*Benthodytes selenkiana.*

ANATOMY OF THE ELASIPODA.

EXTERNAL CHARACTERS.

The order Elasipoda is distinguished from all hitherto known Holothurioidea by a great number of external characters. In most cases the general appearance makes confusion between the forms of this order and those of the Apoda and the Pedata impossible. The Apoda are either of a strongly-marked worm-like, usually long, narrow, cylindrical shape, or of a fusiform one, with the posterior extremity more or less elongated and strikingly tapered. As an example of the former may be cited *Synapta*, Eschsch., *Chirodota*, Eschsch., *Haplodactyla mediterranea*, Grube, &c., and of the latter *Caudina*, Stimps., *Molpadia*, Cuv., *Haplodactyla molpadioides*, Semp., &c. In addition, the lack of any traces of pedicels, and of any external demarcation between the dorsal and ventral surfaces characterises the order Apoda. In the Pedata the external appearance is characteristic on account of its more or less distinctly traceable bilateral symmetry, but it is to be remembered that also in this order many forms are known especially in the genera *Thyone*, Oken, *Thyonidium*, Düb and Kor., *Cucumaria*, Blainv., *Ocnus*, Forbes and Goodsir, &c., in which the body is cylindrical or tapered at each end, or even pentangular, the dorsal and ventral surfaces thus being not clearly marked out. In the Aspidochirotæ, especially in the genera *Stichopus*, Brandt, and *Mülleria*, Yäger, but above all in *Psolus*, Oken, and *Colochirus*, Troschel, amongst the Dendrochirotæ, the ventral surface becomes flat, sole-like, and most evidently distinct from the highly convex dorsal surface.

In the Elasipoda the shape of the body is bilaterally symmetrical, the ventral surface being flat or slightly concave, or sometimes insignificantly convex, and as a rule clearly distinguishable from the usually strongly convex dorsal surface. A transverse section of the body (Pl. XXXVI. fig. 4) generally shows a segment, the arc of which is represented by the back, and the straight line by the ventral surface. The body is in some forms rounded or oval, and in others more or less elongated, thus bearing some resemblance to the Aspidochirotæ; sometimes, however, as, for instance, in the genus *Parelpidia*, it has the shape of a more or less narrow cylinder, thus becoming almost synapta-like, in which case there is no marked distinction between the dorsal and ventral surfaces, which can only be determined by the position of the processes and the pedicels. Accordingly, the body of the Elasipoda is generally to be considered as psolus-like, the ventral surface being with few exceptions flat and shorter than the dorsal one. Only in the genus *Parelpidia* do the ventral and dorsal surfaces seem to be of about equal size. Not a single species is found in which the dorsal surface is shorter than the ventral one, as is known to be the case in several of the Dendrochirotæ. Sometimes the breadth exceeds the height, and this occurs most conspicuously in the genera *Scotoanassa*, *Euphronides*, and *Psycheotrephes*, which are very remarkable on account of their great flatness. In other forms as, for instance, *Scotoplanes insignis, Elpidia willemoësi*, &c., the body decreases in height backwards, its posterior portion becoming almost flat, while the contrary may be observed in the genus *Psychropotes*, which is remarkable for the height of its posterior and the flatness of its anterior extremity. In several species, as in *Scotoplanes robusta, Peniagone vitrea, Elpidia willemoësi*, &c., the body is produced anteriorly into a narrow, longer or shorter neck-like part, which is directed straight downwards.

Another peculiarity which characterises the external appearance in a great number of Elasipoda is the presence of a brim which surrounds either the posterior extremity of the body as in *Scotoplanes insignis, Elpidia willemoësi*, &c., or both the posterior and the anterior extremities, as in *Scotoanassa diaphana*, or only the anterior one, as in *Elpidia purpurea* and *Enypniastes eximia*, or which, finally, extends round the whole body, as in the Psychropotidæ, where it sharply defines the dorsal from the ventral surface. The brim in question, which originates in an enlargement of the layer of connective tissue of the perisoma, is broad and rather thin, and the wide tubes which penetrate it and unite the pedicels with the ambulacra often become visible externally, thus giving the brim a somewhat fin-like appearance. Sometimes, as in *Scotoplanes insignis* and *Elpidia willemoësi*, &c., this fin-like brim becomes bipartite at the posterior extremity. The Psychropotidæ are easily distinguished by the possession of this brim, which surrounds the body and attains such a breadth at the anterior end as to give it the appearance of a more or less distinct head.

The two orders Apoda and Pedata sometimes have the mouth and anus almost terminal at opposite poles of the cylindrical or fusiform body, sometimes on the contrary directed upwards, as in several Dendrochirotæ remarkable for their ascidia-shaped body. In a great number of Aspidochirotæ the mouth and the oral disc are more or less distinctly turned towards the ventral surface.

In the Elasipoda the mouth and the surrounding oral disk, though situated either at or near the anterior end of the body, are always more or less evidently directed towards the ventral surface; in many forms, indeed, the mouth lies in the same plane as the ventral surface. Even in forms characterised by a body of cylindrical shape, as, for instance, *Parelpidia*, the oral disk has a slight though definite ventral inclination. Again, one cannot invariably describe the mouth as terminal, because in numerous forms such as *Elpidia purpurea*, and in all the Psychropotidæ the dorsum projects considerably beyond the mouth. Now, the under surface of this projection lies in the same plane as the ventral surface or trivium, and thus the mouth seems to be placed on the ventral surface at some distance from the anterior extremity.

Here, then, it is evident that the dorsum projecting beyond the mouth constitutes in a measure the anterior end of the body, but it is of importance to remember that the peritoneal cavity does not extend beyond the mouth, or, at most, very slightly, so that the projection is really due to an increase in thickness of the dorsal body-wall itself. At the same time, we seem to have here a more pronounced example than is elsewhere seen of the tendency of the mouth to become removed from its terminal position.

As noted above, Elasipoda are found in which the mouth is placed at the end of a narrow neck-like part, which is bent downwards so as to form an angle with the ventral surface; this is the case in *Peniagone vitrea*, *Elpidia willemoësi*, &c. In a very few forms among the Elasipoda, as, for instance, in the genera *Deima* and *Benthodytes selenkiana*, &c., the mouth and the tentacles are capable of being entirely retracted within the body. All the individuals of the genus *Deima* I have had at my disposal are especially remarkable for the fact that the tentacles are always enclosed within the cavity, which forms the most anterior part of the alimentary canal and communicates with the exterior by an aperture which seems capable of being entirely closed (Pl. XLIII. fig. 3). This aperture lies in the centre of a radially-wrinkled disk, and is surrounded by a single crown of small papillæ (Pl. XLIII. fig. 2), the importance of which will be discussed further on. I do not think it probable that *Deima*, in which any solid oral disk seems absent, should not be able to extend the disk and its tentacles outside the body. It is unnecessary to state that this capacity of retracting the mouth and tentacles within the body is not peculiarly characteristic of a few forms in the order Elasipoda; for numerous species among previously known Holothurioidea, and particularly the Dendrochirotæ, also possess this power.

In the Pedata and the Apoda the tentacles are generally arranged in a single row round the mouth, and it is well known that only in a very few cases, viz., the genus *Phyllophorus*, Grube, and *Synapta bifaria*, Semper, exceptions are found where the tentacles are disposed in two circles, an outer and an inner one. The tentacles, though usually of equal size, are sometimes unequal, as in *Echinocucumis*, Sars, and sometimes, as is the case in a great number of the Dendrochirotæ, a couple of the ventral ones is considerably smaller than the others. It is also well known that the genus *Thyonidium*, Düb. and Kor., is characterised by the possession of five pairs of large alternating with five pairs of smaller tentacles, and that *Orcula*, Troschel, carries from ten to twenty tentacles, of which five are always smaller than the rest. The tentacles vary highly in shape, and are grouped by Semper in the following manner:—tentacula peltata in the Aspidochirotæ; arborescentia in the Dendrochirotæ; peltata and pinnata in the Molpadidæ; digitata, pinnata, and peltato-digitata in the Synaptidæ. In *Haplodactyla*, Grube, belonging to the Molpadidæ, the tentacles present their simplest conformation, and deviate from the common type in being unbranched and without any enlarged terminal part, thus plainly showing that the tentacles in general are to be regarded as simply modified pedicels. The tentacles in the orders Apoda and Pedata varying in number from ten to twenty-five, are in general a multiple of five, but notwithstanding this exceptional forms are not infrequently met with, which possess twelve, thirteen, eighteen, or nineteen tentacles.

On examining the tentacles in Elasipoda one finds that they are always arranged in a single crown. I must say, however, that I feel somewhat uncertain concerning the tentacles in the genus *Deima*, because I never saw them fully extended (Pl. XLIII. fig. 3). When drawn inside the body and closely crowded they appear to be irregularly disposed, and have almost the aspect of a double crown. The tentacles of the Elasipoda are generally to be regarded as equal in size, though it may be noted that sometimes one or several present a distinct tendency to become smaller than the rest. A great number of individuals of the same species having very often been at my disposal, I have had the opportunity of observing that while the tentacles in the more adult individuals are of equal size, those in the young forms are often unequal, one or more being sometimes almost rudimentary; in *Oneirophanta* especially this is obvious, while at the same time it becomes evident that no given tentacle is smaller than the other. However, it must not be overlooked, that even in fully-developed individuals of the above cited genus as well as of *Ilyodæmon*, *Orphnurgus*, &c., some of the tentacles are more or less incompletely developed, only existing in the shape of small protuberances.

The tentacles of the Elasipoda, from ten to about twenty in number, vary considerably in shape; they resemble most the peltate or digitate type as found in the Aspidochirotæ and in some of the Synaptidæ. A more or less stiff stem supports the terminal part, which is either large, round, more or less discoidal, and without any visible processes, or with rudimentary ones as is the case in *Lætmogone*, *Ilyodæmon*, *Achlyonice*, or which is comparatively small and provided with many or few, larger or smaller, simple, digitiform or branched processes (comp. Pl. XLIV.). *Deima* bears comparatively minute tentacles, which seem capable of being fully retracted; in most of the other forms which belong to the order in question, only the processes or their tops are retractile. The tentacular suckers, which according to Quatrefages[1] and Semper are found in a few Synaptidæ, are altogether lacking in the Elasipoda.

The Holothurioidea possess besides tentacles two kinds of external ambulacral appendages, which according to Semper are termed "ambulacral pedicels" and "ambulacral papillæ." These two kinds of appendages are either found in the same animal as, for instance, in *Colochirus*, Troschel, *Mülleria*, Jäger, *Stichopus*, Brandt, and in numerous species of the genus *Holothuria*, L., &c., or they exist singly in different species, consequently there are either only pedicels present as in the most species of *Cucumaria*, Blainville, *Thyone*, Oken, *Thyonidium*, Düb. and Koren, *Holothuria vagabunda*, Sel., &c., or only ambulacral papillæ as in *Holothuria albiventer*, Semp., *Holothuria squamifera*, Semp., &c. The ambulacral pedicels are cylindrical, usually of a comparatively inconsiderable size, and terminate in a kind of disk-like sucker, which is strengthened by a calcareous plate or plates; the ambulacral papillæ, on the contrary, are conical and without any terminal disk-like sucker, are usually dorsal in position, and sometimes attain a considerable size as in *Colochirus quadrangularis*, Less., *Stichopus naso*, Semp., *Holothuria armata*, Sel., &c. The pedicels, which seem to be indefinite in number can with few exceptions be entirely retracted within the body-wall; they are either irregularly scattered all over the body as in *Thyone*, Oken, &c., or disposed in rows all along the five ambulacra as in *Cucumaria*, Blainv., &c., or they are found only on the ventral surface, where they are generally arranged in three rows as in *Colochirus*, Troschel, *Psolus*, Oken, &c. The ambulacral papillæ, which are present in the genera *Stichopus*, Brandt, *Mülleria*, Jäger, *Colochirus*, Troschel, and in most species of the genus *Holothuria*, L., are sometimes disposed in more or less plainly marked rows, but are ordinarily scattered, and show no traces of any regular arrangement; in some cases they are found not only on the dorsal surface, but dispersed all over the body, as in several forms of the group *Sporadipus*, Grube. The form and the position of the pedicels and processes as well as their number being usually well-defined are highly remarkable in the Elasipoda, and give the external configuration of the body its characteristic appearance. Consequently, it is of the greatest importance to point out as plainly as possible in what respects these organs differ from those in the Pedata. I never found any pedicels fully corresponding to what Semper terms "ambulacral pedicels," and it would be more correct to class all the pedicels of the Elasipoda under the head of "ambulacral papillæ." Thus, when describing the order in question, I prefer to give the name "pedicels" to the ambulacral appendages on the ventral surface, these being exclusively adapted to purposes of locomotion, contrary to those on the dorsal surface, which may be called "processes." Just as the ventral is in most cases obviously distinct from the more or less highly convex dorsal surface, so a generally striking difference may be observed between the ventral pedicels and the dorsal processes, this difference being not only conspicuous in the external shape, in the size and in the number, but also in the corresponding ambulacral cavities or ampullæ, which will be described more in detail under the rubric "water-vascular system." Only a few examples in the Psychropotidæ, viz., *Benthodytes sanguinolenta* and *Benthodytes typica*, exist, which correspond with several forms in the Pedata in carrying on the dorsal surface a number of appendages which by their narrow cylindrical shape, their minute size, and their capability of being entirely retracted within the integument, bear the strongest resemblance to true pedicels. My intention is to give a summary account of these appendages a little further on after having first described the pedicels more in detail.

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[1] Mémoire sur la Synapte de Duvernoy (Annales des scienc. nat., 2 sér. tom. xvii., 1842).

Two kinds of pedicels are distinguishable in the Elasipoda; the first, small, and often resembling rounded protuberances, are generally strengthened by a small number of spicula, their rounded or slightly flattened ends being without any calcareous terminal plate; the second, large, generally cylindrical or conical, more or less stiff, not retractile, but to a certain degree contractile, and with their tops either large, sole-like, or discoidal, as in *Orphnurgus*, *Lætmogone*, &c., or more or less tapered as in *Scotoplanes globosa*, &c.

or, finally, decreasing to a narrow, tube-shaped, retractile prolongation, as, for instance, in *Elpidia glacialis*, &c. But as a matter of fact a strict separation of these pedicels into two groups is not possible, the interval between them being filled up by a series of gradations. Both kinds of pedicels differ from those in the Pedata by the notable peculiarity that they show no traces of a calcareous terminal plate;[1] the genera *Ilyodæmon* and *Lætmogone* are most singular exceptions to this, having the ends of their pedicels supported by one or more perforated plates. In the Psychropotidæ, which in many respects may be regarded as intermediate between the true Elasipoda and the Pedata, the pedicels, having lost much of the typical form characteristic of the deep-sea Holothurians and evidently approaching those in the Pedata, belong to the first, that is to say, to the small kind. Some of these pedicels are more or less minute, and are arranged in a double row all along the odd ambulacrum; others are slightly larger and form a single row round the margin of the brim of the body. The large cylindrical pedicels which, on the contrary, are present in the other two families, are disposed in a single row along each of the lateral ambulacra on the ventral surface. As the only known exceptions I may cite *Oneirophanta mutabilis* and *Ilyodæmon maculatus* in which the pedicels in question are disposed in a double alternate row along each side of the ventral surface, while the first-mentioned species as well as the genus *Pannychia* are the only forms excepting the family Psychropotidæ which carry pedicels on the odd ambulacrum, the former carrying few, the latter many. As above mentioned, only a comparatively small number of the Elasipoda have all three ambulacra provided with pedicels, while the majority carry along each side of the ventral surface only a single row of large cylindrical, locomotory pedicels. These large pedicels, which are to be regarded as direct protuberances of the body-wall are often strengthened by calcareous deposits, more or less closely resembling those in the perisoma in form as well as in number. Thus, for instance, if the body-wall itself is firm and brittle, as in *Oneirophanta*, *Deima*, &c., the pedicels also become highly brittle and inflexible. In order to give an idea of the size of these larger pedicels I refer to the following list:—

	Length.	Diameter at the base	Diameter at the top.
Oneirophanta mutabilis, ...	16 mm.	6·5 mm.	5 mm.
Deima validum, ...	10 „	10 „	—
Lætmogone violacea, ...	12 „	8·5 „	4·5 mm.
Ilyodæmon maculatus, ...	15 „	8 „	5–·6 „
Orphnurgus asper, ...	20 „	6 „	4 „

Here I may again refer to the peculiarity, which has already been mentioned in my description of the species, that the posterior pedicels in several forms of the family Elpidiidæ as, for instance, in *Scotoanassa diaphana, Scotoplanes insignis, Elpidia willemoësi,* &c., are webbed together by a thin skin, which gives to these forms a most peculiar appearance. Besides, it must not be forgotten that the posterior pedicels in *Parelpidia elongata* differ from the anterior, elongate, cylindrical ones, and present a form peculiar to themselves; these posterior pairs of pedicels (Pl. I. figs. 3 and 4), are large, flattened, oar-shaped, taper towards their tops into an acute point, while the odd, hindmost, and very flattened pedicel attains a considerably greater breadth and has its obtuse end incised. The lateral pedicels in the family Elpidiidæ vary considerably as to their position and deserve special attention. They are, for instance, more thinly scattered anteriorly than posteriorly, where they are commonly crowded close together, side by side. The genera *Parelpidia* and *Peniagone,* excepting *Peniagone affinis, Elpidia purpurea, Elpidia verrucosa, Scotoplanes robusta, Scotoplanes insignis,* and *Scotoanassa diaphana* carry pedicels either round the posterior half of the ventral surface or only round the hindmost portion of the body. Besides, the size of the lateral pedicels seems to vary considerably in the very same animal. In the family Psychropotidæ the lateral pedicels are nearly of the same size all round the body, while in the two other families it may be affirmed as a rule that the size decreases posteriorly, so that the most posterior pairs become obviously smaller than the anterior or almost rudimentary. Nevertheless, I have found cases, as, for instance, *Parelpidia elongata,* which form exceptions to this rule in having the posterior considerably larger than the anterior pedicels.

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[1] Special attention should be paid to what has been pointed out in the description of species given above, that various representatives, especially in the Psychropotidæ, for some reason or other possess no calcareous deposits, wherefore it is possible—though not probable—that in these very animals calcareous terminal plates should have existed supporting the ends of the pedicels.

The most characteristic mark of the Elasipoda, and that which gives them their symmetrical appearance, is that the pedicels along each side of the ventral surface correspond in number as well as in shape and size, and, being distinctly opposed to one another, constitute pairs. It sometimes happens, however, though rarely, that the number of pedicels on one side exceeds that on the other, but considering that this is the case in one individual while another of the same species has an equal number of pedicels along each side, this must be regarded only as an individual peculiarity. But, besides this symmetry in the arrangement of the pedicels, there may often be observed in the different species a tendency in the pedicels to become definite and fixed in number. Numerous individuals of *Elpidia glacialis* and *Scotoplanes globosa* having been at my disposal, I have found as a rule that the former species is always provided with four pairs of pedicels and the latter with seven pairs. Unfortunately, I have had only one or two individuals of most species for my examinations; consequently I am not able to cite more examples, though I am fully convinced that all forms belonging to the family Elpidiidæ possess in common with the two forms above mentioned an almost fixed number of pedicels. Before concluding my account of the pedicels, it is necessary to notice the two forms *Oneirophanta mutabilis* and *Ilyodæmon maculatus* in which the pedicels are arranged in a double row along each side. This arrangement in a double row is often not very plainly marked, and now and then there is only a single though slightly irregular row distinguishable. The pedicels in the inner row being fewer in number and smaller in size than those in the outer row seem to be developed subsequently; and this fact becomes most evident on examining very young individuals in which the inner pedicels are usually rudimentary, while those in the outer row are well developed.

The dorsal surface is supplied with processes which in most cases strikingly differ from the pedicels, but which sometimes, as, for instance, in *Benthodytes sanguinolenta* (Pl. XLII. fig. 6) and *Benthodytes typica* (Pl. XLIV. fig. 8) resemble the pedicels in Pedata by their smallness and cylindrical shape as well as by their capability of being entirely retracted within the body, but it must be remembered that their rounded terminal part is without the characteristic disk-like sucker with its supporting calcareous plate. It is of great importance to pay special attention to the fact that—though the difference between the ventral and dorsal ambulacral appendages is generally so plainly marked that no further explanation is necessary with regard to the two terms "pedicels" and "processes"—a transition, nevertheless, is found between them, consequently, no definite limit can be marked; however, their functions being unquestionably diverse, the use of different terms is fully justified. Even those Elasipoda which carry on their dorsal surface small foot-like appendages never use the rounded, convex dorsum for the purpose of locomotion, but move forwards on their flat, ventral surface, which becomes fully evident when we consider the position of the mouth, &c. Thus it would be inaccurate to term these foot-like dorsal appendages pedicels, which, being present only in a few forms, are most certainly just as inapplicable for the purpose of locomotion as the large dorsal processes or appendages.

The dorsal ambulacral appendages are either simple or compound; the former I prefer to call processes, and the latter appendages. Both kinds are often found in the same animal, and vary considerably in size as well as in form and position.

The processes are regularly more or less elongated, conical, and sometimes tuberculous, and often attain a size so considerable as not to admit of being retracted within the body, excepting in the genus *Ilyodæmon,* which seems to have all the dorsal processes completely retractile, which is probably owing to their communication with true ampullæ (Pl. XLII. fig. 3). In the Deimatidæ the processes attain the greatest size, and it ought to be specially pointed out that *Oneirophanta mutabilis* and *Lætmogone wyvillethomsoni* carry processes of the same length as the body itself, thus reaching a length of 125 mm. or more. The processes are in general more or less flexible, but in certain forms, as, for instance, in the two species of *Deima*, they are very stiff and directed straight out from the body, thus bearing a resemblance to gigantic spines. Sometimes, as in *Parelpidia*, the processes are extremely minute, almost rudimentary. I have recently drawn attention to the small foot-like and completely retractile processes in *Benthodytes sanguinolenta* and *Benthodytes typica.*

The dorsal processes belong in general to the dorsal ambulacra, but exceptions have been found in *Deima*, *Oneirophanta*, *Orphnurgus*, and *Pannychia*, which carry processes not only all over the dorsal ambulacra but also in a row situated above the pedicels along each side of the body; these lateral processes are in communication with the ventral lateral ambulacra, which thus carry both pedicels and processes. *Colochirus*, Troschel, &c., among the Pedata, proves that this is a peculiarity not exclusively characteristic of these four forms. In all the Deimatidæ, as well as in several forms belonging to the Psychropotidæ, the dorsal processes are arranged in one or several rows along each ambulacrum. Those animals which, as, for instance, *Oneirophanta* and *Deima* are provided with processes of unusual size and length, have them disposed only in a single row. Very rarely, and, as far as I know, only in *Benthodytes sanguinolenta*, and possibly in *Pannychia moseleyi*, the processes are found scattered over the lateral interambulacra. In the family Elpidiidæ, on the contrary, traces of such an arrangement in rows are obvious, but the processes are fewer in number and the rows have a tendency to become dissolved. A closer examination of the representatives of the family in question shows that the processes do not as a rule change their position, but are situated at fixed places, either anteriorly, or both anteriorly and posteriorly, thus leaving a greater or smaller portion in the middle of the back devoid of all processes. At the same time it will be seen that the number of the processes is definite, as in *Scotoplanes globosa* which always carries only three pairs,—a very remarkable peculiarity, which is, doubtless, to be found in most of the representatives of the family in question, though through lack of necessary material I have not been able to distinguish it; in some forms, as, for instance, in *Elpidia glacialis*, they vary a little in size as well as in position, but even here can be found traces of a tendency to become definite in number and position. In the Elpidiidæ the processes are most evidently disposed in pairs, and though the latter themselves are of a very variable size when compared to one another, nevertheless each pair is made up of processes of equal size.

As before noted another kind of dorsal ambulacral appendage is present, which, being generally odd and very large, traverses the bivium from the one ambulacrum to the other, and appears to be made up of one pair of processes or more, viz., it is penetrated by one or several pairs of wide tubes which are in communication with the two dorsal ambulacra. It is most evident that since the animals are supplied with such a large and long appendage, which either has its free end rounded or provided with lobe-like processes, their appearance is highly characteristic. In *Peniagone*, *Scotoanassa*, &c., the appendage in question is situated anteriorly, and is usually broad, flat, and made up of several pairs of canals; in *Euphronides* it is placed a little behind the middle of the dorsum, and presents a more conical form, while in *Psychropotes* it protrudes near the posterior extremity of the body, and is remarkable for its gigantic size and tail-like aspect; the appendages of the two last-mentioned genera are penetrated by a single pair of canals. Besides these transverse appendages, one or several pairs of more or less rudimentary processes seem to be present as a rule.

THE BODY-WALL.

The structure of the solid sac termed the body-wall or the perisoma, which encloses the spacious peritoneal cavity and gives to the animals their form, has been already very satisfactorily described by Baur,[1] Semper,[2] Teuscher,[3] &c., and, the material being so softened and macerated by a long immersion in spirit as to make a closer histological examination impossible, I have nothing of importance to add to their investigations, and refer to the splendid memoirs of these authors. Notwithstanding the previously-known facts, I think it may be well to state some points which I have observed when examining the deep-water forms, and which may possibly aid to throw light upon the whole class.

The body-wall consists, as already known, of an outer cellular ectoderm, covered externally with a very thin, transparent cuticule; beneath the ectoderm is a layer of connective tissue, the corium, within which are to be seen circular and longitudinal muscular fibres lined internally with a delicate peritoneum. Corium is of the greatest importance not only in being the secreting layer of the calcareous deposits peculiar to the Echinoderms, but also by reason of its more or less considerable thickness, which occasions striking changes in the shape of the body. The thickness of this layer of connective tissue varies much in different species, and even in the same individual is not always uniform throughout the whole body. According to Selenka,[4] the body-wall in the genus *Stichopus*, Brandt, is always thicker along the interval between the ventral and dorsal surfaces; the same applies to the Elasipoda, in which *Deima* and *Oneirophanta* form good examples, having the large, branched, ambulacral cavities of their lateral pedicels and processes lying inside the thick layer of connective tissue. This peculiarity distinguishes to a very great extent the whole of the Psychropotidæ, the representatives of which have the perisoma increased in thickness all around the body, so as to form a more or less considerable brim (Pl. XL. fig. 6). The singular large appendage which is present on the back in a great number of Elasipoda is likewise for the most part made up of connective tissue.

The tentacles, the pedicels, and the processes are composed of the same layer of tissues as the body-wall proper, excepting that no circular muscular fibres are to be found. In various forms, as, for instance, in *Deima validum*, &c., the layer of connective tissue, particularly that in the processes, attains a high degree of development (Pl. XXXVII. fig. 8). In the pedicels of the above-mentioned species I have found that the connective tissue consists of three easily distinguishable layers,—an outer which contains the large calcareous plates, an intermediate of a loose and fibrous texture in which small spicules of various shapes are present, and an inner layer which forms a dense, thick, hyaline and elastic tunic immediately beneath which the muscular coat of longitudinal fibres is situated. The tunic in question, which is distinguished by having numerous transverse closely-placed wrinkles of about equal size, seems to be very intimately united with the longitudinal muscular layer, because when isolating them from one another the tunic bears evident impressions of the muscular fibres. I did not ascertain that the processes or the tentacles of this animal possessed such an elastic tunic, which however should be present; it was probably very thin, and thus escaped my attention. In the dorsal processes of *Lætmogone wyville-thomsoni* I have likewise observed a corresponding membrane or tunic.

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[1] Beiträge zur Naturgeschichte der *Synapta digitata*, 3 Abhandlungen, mit 8 Tafeln (Nov. Act. Acad. Cœs. Leop.—Carol., tom. xxxi., Dresden, 1864).

[2] Reisen im Archipel der Philippinen, ii., 1, Holothurien, Leipzig, 1868.

[3] Beiträge zur Anatomie der Echinodermen (Jenaische Zeitschr. f. Naturwiss. Bd. x., Jena, 1876).

[4] Beiträge zur Anatomie und Systematik der Holothurien (Zeitschr. für wissensch. Zoologie, xvii., 1867, p. 315).

The principal forms in which the calcareous deposits are presented in the Elasipoda are, strictly speaking, only three—spicules, wheels, and plates. The body-wall is usually supple and pliable because its calcareous skeleton is composed of spicules or wheels which are more or less dispersed in the substance of the corium; in *Elpidia glacialis*, *Elpidia verrucosa*, *Scotoplanes murrayi*, *Peniagone vitrea*, *Scotoanassa diaphana*, &c., these spicules lie so closely crowded and overlapping one another that the perisoma becomes exceedingly brittle, while at the same time the animal loses the power of changing the shape of its body in proportion to the degree of hardness of the integument. In a very few cases, *Deima* and *Oneirophanta*, the integument is strengthened by a great number of perforated, larger and smaller, conspicuously overlapping plates (comp. Pl. XXXI.), which constitute an almost continuous and immovable shell.

Different kinds of calcareous bodies are often found in one and the same animal; thus *Lætmogone wyville-thomsoni* is provided with wheels and simple spicules (Pl. XXXI. figs. 14–16), *Lætmogone violacea* with wheels and cruciform bodies (Pl. XXXVI. figs. 20–24), and *Ilyodæmon maculatus* is most particularly characteristic in having, besides wheels, dichotomously branched, flat and discoidal bodies, which are partly scattered, partly crowded in great numbers (Pl. XXXVI. figs. 12–19).

The spicules appear variously shaped, but are, nevertheless, derived from two principal forms—simple and branched (Pls. XXXII.–XXXV.). Among the former there is to be noted, firstly, the C-curved type, which has hitherto been regarded as characterising the genus *Stichopus*, Brandt, but is now known to be present in all the representatives of the genus *Scotoplanes*, and in some of the genus *Peniagone*; secondly, the simple, straight, or inconsiderably curved, spinose rods, which are found in several species, as, for instance, in *Scotoplanes albida*, *Scotoplanes globosa*, &c.; and lastly, the minute more or less highly arcuated and spinose spicules, conspicuously thickened in the middle, which are seen in *Irpa*, Dan. and Kor., and *Kolga*, Dan. and Kor. Special attention should be paid to the peculiarity that the C-curved bodies which are found in *Stichopus*, Brandt, as well as in the Elasipoda always present a significant dilation at their middle. The branched spicules seem to be present in the majority of the deep-water forms, and may be considered as especially characteristic of the two families Elpidiidæ and Psychropotidæ; they are made up of four or sometimes three more or less spinose and arcuate arms, and are supplied either with only a single outwardly-directed spinose central process or with several such, which give to the surface of the body-wall a high degree of roughness. It is very surprising to find the wheel-shaped deposits represented in several forms of Elasipoda, for these calcareous bodies have always been considered as characteristic of only a few genera of the apodal Holothurids, viz., *Myriotrochus*, Steenstrup, *Chirodota*, Eschscholtz, *Trochoderma*, Théel, and *Acanthotrochus* Dan. and Kor. Two kinds of wheels are distinguishable, viz., large or true wheels and small ones resembling plates, the former of which seem to be never present unless associated with the latter as is the case in *Lætmogone*, *Ilyodæmon*, and *Pannychia*, while the latter, on the contrary, seem to be more independent of the presence of the former, and are sometimes found together with spicules (Pl. XXXII. figs. 21–23, and Pl. XXXIII. fig. 6), as in *Achlyonice lactea*, *Elpidia ambigua*, &c. I do not intend to give any detailed account of the structure of the wheels, but refer back to the description of the species. I only intend to draw attention to the fact that the regularly large nave has in its centre a large hole, from the edge of which an inwardly-directed crown, made up of four to five arcuated arms, rises. I have observed, especially in *Pannychia* and *Ilyodæmon*, that this central hole is sometimes covered with a thin, transparent calcareous membrane pierced by a few sometimes minute openings (Pl. XXXII. fig. 6), the centre of this calcareous membrane being connected with the top of the crown by a short, straight, calcareous rod.

The plates which are present in *Deima* and *Oneirophanta* are of a different structure; those which belong to the former genus are composed, that is to say made up of several layers (Pl. XXXI. figs. 5 and 11), while the plates in the latter genus are simple, discoidal, and flat. The simple as well as the compound plates vary considerably in size, the larger being mingled with the smaller ones; the largest plates I have seen in *Oneirophanta* measure about 2 or 3 mm. in diameter, while those in *Deima fastosum*, attain to 5 mm., and in *Deima validum* to about 7 mm. diameter. The simple plates are perforated by numerous holes, which are always largest at the centre and diminish gradually towards the circumference, where they become almost indistinguishable; the innermost layer of the compound plates resembles the simple ones in the fact that the perforation is more regular and the rather rounded holes decrease towards the circumference, and upon the upper surface of this inner plate, or rather layer, rises a more irregular network, which in *Deima fastosum* appears like a large conical knob (Pl. XXXI. fig. 10), while in *Deima validum* it does not attain such a development, but only gives to the exterior surface of the plates a slightly convex aspect. The compound plates are built up in the following manner:—from the upper surface of a more or less regularly perforated simple plate, that is to say, from the innermost layer of the compound plates, which thus seems to be developed first, a number of minute processes rise, from the tops of which branches run out which join with one another and constitute an irregular network, which in its turn gives rise to another net-work which lies above it, &c. *Oneirophanta* furnishes most evident examples that the development takes place as above described, because the plates, though they are simple, carry on their upper surface one or several small processes (Pl. XXXI. fig. 1), which in most cases remain unbranched, but which sometimes give off small branches from their tops, which unite and form a rudimentary network on the upper surface of the plate.

Both plates and wheels take their origin from the same typical form, viz., a small spicule provided with four short arms (Pl. XXXII. fig. 3), and more than once I have had occasion to state the correctness of this view. In its first stage of development the plate always presents the appearance of a spicule, the four arms of which increase in size and give off branches, which, connected with each other, form the larger holes which are always situated in the centre of the plate; round the edge of this primary plate new holes arise successively by means of the development of new processes which become connected with one another. Though it may seem very strange, the wheels in the Elasipoda are developed in the same manner. As has been already noted the wheels in this order are remarkable for having a small central crown made up of four, rarely five or six, short arched arms; this crown, which ought to be regarded as a four- to six-armed spicule (Pl. XXXII. fig. 3), becomes first visible, and its more or less curved arms, being linked together by their ends so as to form four to six holes, give rise to an irregular ring (Pl. XXXII. fig. 2), which is the first indication of any nave. This nave increases in size and gives off round the edge small, conical processes (Pl. XXXII. fig. 4), which growing larger become spokes which in their turn send out branches towards each side; these branches joined together with one another form the felly. The wheels in *Myriotrochus*, Steenstrup, *Trochoderma*, Théel, *Chirodota*, Eschsch., &c., which lack the crown as well as the large hole in the centre of the nave, are developed in a slightly different manner. In these forms the wheels do not take their origin from a spicule but from a calcareous star, which gives off as many small processes or rays as there are spokes; the further development takes place as above described.

When the calcareous bodies are examined with a high magnifying power and treated with a dilute acid and some colouring matter, it will easily be seen that they are surrounded by a thin membrane which sometimes seems to communicate with fine threads, which either belong to the surrounding connective tissue or are nerve fibres. A central canal is often discernible within the calcareous deposits. In the hope of obtaining a favourable specimen for showing how the calcareous deposits are developed, I examined the very minute pedicels in some very young individuals of *Oneirophanta*, which pedicels were evidently in an early state of evolution. The extremely thin walls of the pedicels contained only a few small, simple spicules, which, more or less developed, were always surrounded by an evident sheath, and this when treated with hæmatoxylin became deeply coloured and very manifest. Supposing the sheaths to be developed first,—the calcareous matters being subsequently produced by them,—I expected to find small empty sheaths, and I succeeded in doing so. The smallest sheath I could discover attained the inconsiderable length of 0·08 mm. (Pl. XXXVI. fig. 8), and was consequently extremely minute in proportion to the adjacent more developed sheaths, which had a length of about 0·7 mm. The walls of the sheaths are extremely thin and contain scattered cells. I did not discover any epithelial lining, which Semper[1] has observed inside the sheaths in the Synaptidæ. As the material which has been at my disposal has not been sufficient to admit any satisfactory examination, it is possible that such an epithelial lining is present though it has escaped my attention. When stained with a solution of hæmatoxylin the sheaths become violet, while the structureless matters which they contain remain almost colourless. The sheaths increase and gradually assume the shape of a spicule. I have first discovered calcareous matter inside them when they have attained a length of about 0·20 mm., which, in the shape of a minute, elongate bright body (Pl. XXXVI. figs. 10 and 11), is situated in the centre of the hitherto structureless substance; sometimes two small calcareous bodies are present. At the same time that the carbonate of lime appears, a concentric structure becomes obvious within the substance enclosed by the sheath, which structure is most conspicuous round the minute recently-formed calcareous body. The sheaths increase, approaching gradually the shape of the future calcareous spicule, while the calcareous deposits themselves grow larger, until they finally become most closely encircled by the wall of the sheaths. It is most probable that a solution of lime-salts is secreted by the walls of the sheaths, and that the calcareous bodies are deposited from this secretion.

The shape of the calcareous deposits varies at different places in the body. There is, for instance, a certain difference traceable between the deposits of the dorsal surface and those of the ventral one with regard to their shape as well as to their number. The dorsal surface seems regularly to be rougher than the ventral, and consequently the calcareous deposits of the latter surface are often fewer in number, smaller and of a more irregular form, their outwardly-directed processes, which cause the roughness, being short or sometimes altogether wanting. The tentacles, the pedicels, and the dorsal processes are towards their ends strengthened by a greater or smaller number of more or less simple spicules, the shape of which is discussed under the description of the species. The dorsal processes are usually supported by a smaller number of spicules, which seem sometimes to be absent, in which case the walls of the processes are provided with calcareous deposits of the same shape as those which are present in the real body-wall. In the processes of *Oneirophanta mutabilis*, a number of long rods are found, the ends of which are enlarged, flattened, and perforated (Pl. XXXI. fig. 2); it is most peculiar that these rods do not lie transversely but in the direction of the length of the processes, the flexibility of which becomes thus rather limited. In *Lætmogone* (Pl. XXXIV. fig. 1), *Ilyodæmon*, and *Pannychia* (Pl. XXXII. fig. 11) alone the terminal parts of the pedicels are supported by one or several perforated terminal plates, which in the last-mentioned genus are covered externally by another more irregular and fragile network. It is of great interest to note that this exterior network can be developed from the small wheels which are present in a great number in the body-wall and even in the pedicels; a glance at Plate XXXII., fig. 12, will give plain evidence of this fact. The felly of the wheels gives off branches which become connected with one another, and construct an irregular network which grows gradually larger, while at the same time the original wheel becomes reduced and finally totally disappears.

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[1] Reisen im Archipel der Philippinen, pp. 30, 31, pl. vii. fig. 2, d.

Concerning the two muscular layers of the body-wall I have nothing of importance to note. In different species these layers attain different degrees of thickness. The circular muscular fibres, or rather the transverse ones, constitute a thin layer which, extending from the one ambulacrum to the other, seems to be divided into five areas separated from one another by the ambulacra. Danielssen and Koren[1] have stated the same to be the case in *Kolga hyalina*. According to these authors, however, *Elpidia glacialis* should have a continuous circular muscular layer anteriorly as well as posteriorly, while this layer should be divided into areas at the middle of the body.[2] The longitudinal muscular fibres are disposed in five simple bands; no sign of a division into two parts is present, if the tendency of the muscular fibres to be crowded towards each side be not regarded as such, only a few fibres being discernible along the middle of each muscular band. The connective tissue which combines the muscular fibres contains in general calcareous spicules. The longitudinal muscular bands do not send out retractor muscles towards the gullet.

THE CALCAREOUS RING.

All the Elasipoda possess an internal skeleton in the shape of a calcareous ring, which surrounds the gullet and is in most cases of such a peculiar structure that it forms an important characteristic of the order in question. Unfortunately, the material which has been to my disposal was too insufficient to allow an examination of as many forms as was desirable, notwithstanding which the results of my researches are of the highest interest. The composition of the calcareous ring in the Pedata and Apoda being already well known it is unnecessary to enter into particulars. The ring is composed of ten or more usually solid pieces or ossicles of a net-shaped structure, the five pieces of which, corresponding to the longitudinal muscles, are termed radial. In very few cases as, for instance, in *Embolus*, Selenka, the calcareous ring is entirely absent, and sometimes it is more or less rudimentary.

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[1] Echinodermer fra den Norske Nordhavsexpedition, p. 86 (Nyt Magazin for Naturv., Bd. xxv., 2; Christiania, 1879).

[2] *Loc. cit.*, p. 100.

In the Deimatidæ the calcareous ring is made up of a fragile spongy network. When trying to isolate the ring from the surrounding tissues it is very often spoiled because of its fragility. In *Lætmogonė* the ring (Pl. XXXVII. fig. 11) seems to constitute a thin continuous network without any visibly separate ossicles and with its exterior part presenting numerous larger or smaller wrinkles. By treating it with a solution of potass, the ring is usually broken in pieces, but five large irregular fragments are commonly left, which are the radial ossicles. To judge by the insufficient material which has been at my disposal, the calcareous ring in *Ilyodæmon maculatus* is constructed in the same manner as that of the former species, though it differs by being perforated for the passages of the ambulacral nerves and vessels. In *Oneirophanta mutabilis* the ring is more plainly made up of radial and interradial pieces, the radial ones being comparatively solid, of a more definite shape, and notched instead of being perforated (Pl. XXXVII. fig. 4). The interradial pieces, fifteen (?) in number, are more fragmental, cup-shaped, and extremely fragile. The calcareous ring (Pl. XXXVII. fig. 3) seems to be of the same construction in *Deima* as in *Oneirophanta*, though possibly more fragile.

Amongst the three families which belong to the order Elasipoda, the Deimatidæ and particularly the genus *Oneirophanta* bear the strongest resemblance to the Apoda and the Pedata with regard to the composition of the calcareous ring. The Psychropotidæ seem to form a transition between the Deimatidæ and the Elpidiidæ, but, unfortunately, I have not had the opportunity to study the structure of their calcareous ring more in detail. Most of the representatives of this family being in a highly macerated condition, the calcareous matters being almost dissolved, and the individuals which remained in an uninjured state being very few in number, any more detailed examination has been impossible. Though the imperfection of our knowledge at present precludes positive assertion, there is every reason to believe that the calcareous ring in the family in question must be highly undeveloped, and made up of an extremely thin and fragile network which does not always form a continuous ring, but, as in *Euphronides depressa* is composed of five small pieces separated from one another. From what I have been able to observe in the Psychropotidæ, each piece seems to bear a certain resemblance to the spicules which compose the ring in some of the Elpidiidæ, but with the difference that, instead of a few, a great number of rods are present, which anastomose with one another and form a network.

All the thirty-one known forms of the Elpidiidæ seem to be characterised by having the calcareous ring composed of only five spicules which are either firmly united with one another, thus forming a pentagonal figure which surrounds the gullet as in *Elpidia glacialis*, or are more loosely combined with one another, by having the arms of the spicules not lying side by side as in the preceding species, but only joined with one another by their ends as is the case in *Kolga hyalina*, Dan. and Koren, or, lastly, the spicules are separated at certain distances from one another, as is plainly shown in most of the species. The various kinds of rings may with advantage be described more in detail.

Each spicule which composes the ring consists of a short, insignificant central part, from which a greater or smaller number of rod-like arms diverge towards each side; the ends of these are in general flat, enlarged, perforated and branched, but sometimes simple, pointed, or slightly obtuse. In *Elpidia glacialis* each spicule consists of only eight arms in all, two of which—viz., those two which are placed posteriorly and internally when the ring is in its proper position—are large and, lying along their whole length side by side and closely united to the corresponding arms of the adjacent spicules, help to form a pentangular figure; of the rest of the arms the posterior outer ones join one another at their ends, and this sometimes seems to be the case even with the anterior inner ones. A correct idea of the composition of this calcareous ring may be gained by referring to my report on the Elpidia.[1] According to Danielssen and Koren[2] each spicule in *Irpa abyssicola* is likewise composed of eight rod-like arms, four of which diverge towards each side, but judging by the description and plates given of these authors, the combination between the separated spicules cannot take place in the same manner as in *Elpidia glacialis*; most probably some of the arms reach or cross the corresponding arms of the adjacent spicules, thus constituting a pentagonal ring.

According to the observations of the same authors[3] each spicule in *Kolga hyalina* gives off fourteen rods, seven of which diverge towards each side; several of the posterior rods, which are the longest, join their ends to those of the adjacent spicules, thus forming a complete pentagonal ring. In all the eight or nine species of this family which I have had the opportunity to examine, the five spicules are found at certain distances from one another, consequently no complete ring is present. Each spicule in *Scotoplanes globosa*, *Scotoplanes papillosa* (Pl. XXXVII. fig. 12), and *Scotoplanes robusta* (Pl. XXXVII. fig. 9) is made up of eight rods, of which four diverge towards each side. *Peniagone vitrea* possesses spicules, which send out about sixteen rods, eight towards each side; and each spicule in *Elpidia willemoësi* (Pl. XXXVII. fig. 1) and *Parelpidia elongata* (Pl. XXXVII. fig. 2) is remarkable for possessing as many as twenty or thirty rods.

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[1] Mémoire sur l'Elpidia (Kongl. Sv. Vet.—Akad. Handl., Bd. xiv. No. 8, Stockholm, 1877).

[2] Echinodermer fra den Norske Nordhavsexpedition (Nyt Mag. for Naturvid., Bd. xxiv. 3).

[3] Echinodermer fra den Norske Nordhavsexpedition (Nyt Mag. for Naturvid., Bd. xxv. 2, 1879).

THE NERVOUS SYSTEM.

The nervous system corresponds fully with that in other Holothurioidea. It consists of a ring (Pl. XLV. fig. 5), which lies superficial to the calcareous ring and to the circular water-vessel, and which sends off five cords, which proceed along the middle line of the longitudinal muscular bands, to the opposite extremity of the body. From the five cords already mentioned branches proceed to the pedicels and processes, while the ring gives off nerves to the tentacles as well as to the mouth. There is no difficulty in following the nerve-branches to the tops of the pedicels and tentacles, but I have not been able to discover in what manner they terminate. It would seem that they divide into fine filaments which are in relation to the more or less elongated cells which are present in great numbers at the ends of the pedicels and tentacles.

In all the Elasipoda there exists a very well-developed delicate peripheral plexus of nerves (Pl. XLV. fig. 1), formed by the branching and interjunction of an indefinite number of larger and finer threads or fibres, which are in connection with numerous ganglionic cells with distinct nuclei, and are often produced into several processes or threads (Pl. XLV. figs. 2, 3); even in the pedicels, tentacles, and dorsal processes such a network is present. The large ambulacral nerves as well as their branches often contain pigment, which is most obvious in *Lætmogone*. Considering the more or less macerated condition of the animals, any closer examination of the histological structure of the nerves has been rendered impossible. What I have been able to distinguish concerning it seems to confirm the correctness of the observations so carefully made by Semper,[1] and Teuscher.[2] Plate XLII., fig. 1, represents a transverse section of an ambulacrum in *Lætmogone wyville-thomsoni* showing the relative position of the radial ambulacral vessel and the neural canal, &c. Leaving the nerves, I now purpose to treat the sensory organs of the Elasipoda.

There is much reason to believe that the dorsal processes and appendages perform in a similar or higher degree than the tentacles the function of tactile organs. Resembling the pedicels in structure, they differ from them by their position and unusual length, size, and flexibility, as well as by their lack of any terminal sucker, and they seem to be organs particularly suited to bring the animals into relation to surrounding bodies. An unusual abundance of nerves radiating towards the exterior layer of the perisoma is a special characteristic of the processes (Pl. XXXVII. fig. 8).

In the Deimatidæ and the Psychropotidæ I have found only the sensory organs just mentioned, but most representatives of the Elpidiidæ possess, besides these, olfactory organs in the form of auditory sacs. It is an already well known fact that several of the Synaptidæ have such olfactory organs either attached to the nerve-ring itself or lying immediately in its proximity. Lately Danielssen and Koren as well as myself have exhibited in our respective reports that *Elpidia glacialis* and *Kolga hyalina* are provided with such organs not only at the nerve-ring but also all along the two lateral ambulacral nerves of the trivium.

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[1] Reisen im Archipel der Philippinen, ii., 1, Holothurien, Leipzig, 1868.

[2] Beiträge zur Anatomie der Echinodermen (Jenaische Zeitschrift für Naturwiss., x., Jena, 1876).

In *Elpidia glacialis* the main nerve-cords, excepting the odd one of the ventral surface, communicate at their junction with the pharyngeal ring with a small auditory sac. On making a closer examination of the ambulacral nerves one will find that each of the ventral lateral cords carries these sacs, usually five or slightly more, scattered all over their length, while the remaining nerve-cords seem to be without any such; one or two may usually be observed near the points where the pedal nerves join the main cords. The auditory vesicles are provided interiorly with an epithelial lining, are spherical, about 0·2 mm. in diameter, and seem in general to be attached close to the nerve-cords; they contain five to twenty otoliths of a characteristic ovate shape, with one of the ends rounded, while the other is slightly tapered and truncated. The otoliths (Pl. XXXVI. fig. 25) measure in length about 0·036 mm. and in breadth 0·02 mm., and are made up of from three to four distinct layers, the innermost of which has a granular appearance. When regarding the layers posteriorly, viz., from the rounded end, they are marked out by concentric circles.

Danielssen and Koren mentioned in their already cited memoirs that *Kolga hyalina* possesses no less than fifty-six auditory sacs, two of which are situated close to each of the chief dorsal nerves not far from the ring and twenty-six along each lateral ventral nerve. It is most probably a fact that the odd main cord is regularly without any auditory vesicles, and that the dorsal cords only possess such vesicles anteriorly in the neighbourhood of the pharyngeal ring; at least I never found any exceptions to this rule. According to Danielssen and Koren, each auditory vesicle in the above-mentioned species contains from 20 to 130 otoliths, the form of which is either oblong and composed of different layers, or round and presenting concentric circles. I suppose that these latter, the rounded ones, are only the former observed from the round end, and thus the layers must of course present the appearance of concentric circles. My intention is to enumerate below all the cases in which auditory vesicles have been found, but I draw a special attention to the fact that I have not had the opportunity of examining as many forms as I should have wished, owing to the scanty material at my command.

In *Kolga nana* about thirteen auditory vesicles are present along each of its ventral, lateral nerve-stems, each vesicle containing about twenty otoliths.

In *Parelpidia elongata* auditory vesicles are found at the nerve-ring enclosing up to thirty or thirty-five otoliths, the length of which varies from 0·021 mm. to 0·04 mm.

Elpidia incerta possesses a great number of auditory vesicles disposed along each side of the ventral surface. I counted eighteen to twenty attached to the anterior half of the nerve-stems, to which they seem to be connected either directly or by means of a short branch.

In *Peniagone vitrea* and *Peniagone affinis* a greater number of vesicles are to be observed along both of the ambulacral nerves just mentioned.

There is no doubt that the majority of the Elpidiidæ are characterised by possessing auditory vesicles, and that these are generally disposed in the same manner as in *Elpidia glacialis* and *Kolga hyalina.* Their number as well as that of the otoliths seems to vary very considerably, the latter being sometimes, though in a very few cases, altogether wanting. The otoliths in all the species I have seen are distinguished by the same characteristic ovate shape, with one end rounded and the other tapering and truncated.

THE ALIMENTARY CANAL.

With the exception of a few Synaptidæ, in which it takes a straight antero-posterior course, the digestive tract of the Pedata and Apoda, as well as of the Elasipoda, is of a considerable length and arranged in convolutions. It descends from the mouth to the opposite extremity of the body, where, turning upon itself, it mounts up towards its anterior portion, whence, turning back again, it once more passes backwards directly to the anus (Pl. XL. fig. 2). Thus one can distinguish the following portions of the digestive tract, one descending, another ascending, and a third again descending. As previously pointed out the mouth as well as the anus change their positions in the Elasipoda; the former always has a more or less ventral inclination and is often directed straight downwards, and has a perfectly ventral aspect in the whole of the Psychropotidæ, while the latter is alternately ventral, terminal, and dorsal. The oral aperture, which is closed by a sphincter formed of numerous circular muscular fibres, is situated in the centre of the oral disk, which, surrounded by the tentacles, is only to be regarded as a part of the body-wall itself. The space between the tentacles and the mouth is termed the atrium. As is already known, in the Dendrochirotæ the oral end of the body bears a certain resemblance to a proboscis which is capable of retraction, a capability depending upon the thinness of the integument of the proboscis itself. In the Elasipoda the oral disk is in general thick and almost inflexible because of the more or less crowded calcareous bodies in it, consequently it is not retractile (Pl. XLIII. fig. 1). But exceptions have been found, and particularly in the genus *Deima*, where the oral disk seems to be more or less allied to that of the Dendrochirotæ, and deserves therefore to be described more in detail.

In all the representatives of the genus *Deima* which have been at my disposal, no tentacles have been apparent externally. One finds in the centre of a disk-like portion of the body-wall an aperture, which is closed by large circular muscular fibres (Pl. XLIII. figs. 2, 3.) The disk in question is supplied with a number of radiate wrinkles, and is surrounded by a simple crown of very minute papillæ, the importance of which will be discussed under the rubric "ambulacral system." By means of this aperture the external medium communicates with a spacious cavity, inside which the small completely retractile tentacles are situated, disposed near and around the aperture. It is most probable that the tentacles can be extended outside the body. In the retracted condition of the tentacles and the surrounding perisoma, no traces of any oral disk corresponding to that in the rest of Elasipoda have been found, unless the insignificant circular fold which lies close behind the tentacles may be considered as such. Even in a few other cases, as, for instance, in *Benthodytes selenkiana*, &c., the crown of tentacles can be drawn within the body, but this seems to take place in the same manner as in the Aspidochirotæ, the oral end of the body not being transformed into a proboscis.

The most anterior portion of the alimentary canal is usually dilated into a cavity (Pl. XLIII. fig. 1), which is termed the oral cavity, and which extending backwards close to the circular water-vessel is attached by numerous fine threads to the calcareous ring, to the tentacular canals, &c.; behind the oral cavity a narrower, usually very short, sometimes red or violet portion is to be observed, termed the pharynx, which is separated by a minute circular fold or valve (Pl. XLIII. fig. 1, and Pl. XXXVI. fig. 1) from the long and wide intestine, which, forming the convolutions spoken of before, terminates in the anus, which is closed by a muscular sphincter. The pharynx, which is surrounded anteriorly by the circular water-vessel (Pl. XLIII. fig. 1), and the circular pseudhæmal vessels, is connected with these by numerous strong threads. The cloaca, or the most posterior dilated portion of the intestine being attached to the body-wall by numerous powerful bands and threads is either of very little importance, as in the Deimatidæ and in several forms of the two other families, or it is, on the contrary, well developed and of an unusual size, as is the case in *Elpidia verrucosa*, *Scotoplanes robusta*, *Euphronides depressa*, &c. Some of the representatives of the Elpidiidæ are characterised not only by having an uncommonly large cloaca, but particularly by the fact that the latter gives off a large, wide cæcal prolongation towards the left side, which sometimes extends forwards towards the middle of the body, attaining, at the same time, a very remarkable breadth; such a cloaca is present in the following species:—*Achlyonice paradoxa*, *Scotoplanes globosa*, *Scotoplanes albida*, *Elpidia glacialis*, *Kolga nana*, and *Kolga hyalina*, Dan. and Kor. Sometimes the cloaca seems to vary in size in different individuals of the same species, as in *Benthodytes abyssicola*, &c. In *Deima fastosum* the cloaca is separated from the intestine itself by a small circular fold. In *Oneirophanta* and *Deima* the hindmost or anal portion of the digestive tract is noticeable in that it can be extended beyond the anus which thus becomes surrounded by a circular mound (Pl. XL. fig. 3). By a careful investigation one will find that this anal portion consists of a highly muscular double-wall including a large circular cavity, which, as far as I can judge, possesses no aperture. I have not the least idea of the functions of this cavity, but aggregations of corpuscles resembling blood having often been found within it, it may possibly communicate with the pseudhæmal vessels.

The digestive tract in *Benthodytes sanguinolenta* as well as in *Benthodytes sanguinolenta*, var. *marginata*, is especially characterised by its second descending portion carrying a large, wide cæcal appendage or "diverticulum" about 15 mm. long (Pl. XL. fig. 4), which is situated far from the anus, in the largest individuals at a distance of about 170 mm., and which opens within the digestive tract by a very wide aperture; its structure does not differ greatly from that of the digestive tract.

Having nothing of importance to add to that which already is known, I think it unnecessary to give an account of the histological structure of the walls of the alimentary canal. I only refer to the Plate XXXVI., figs. 1 and 2, which represent some sections showing the different layers which compose the walls. The digestive tract is often strengthened by calcareous spicula of varying shape and size.

The cavity or sinus, which is enclosed between the most anterior portion of the digestive tract and the surrounding water-vascular ring with its five main branches, and which is termed the "œsophageal sinus," is either almost entirely closed by a thin membrane, as in *Lætmogone* (Pl. XLIII. fig. 4), *Elpidia glacialis*, *Benthodytes sanguinolenta* (Pl. XL. fig. 5), *Ilyodæmon maculatus*, &c., or this membrane is absent (Pl. XLIII. fig. 6), the sinus thereby communicating directly with the peritoneal cavity, as in *Oneirophanta*, *Orphnurgus*, &c.

Throughout the whole of its course, the alimentary tube is connected with the wall of the body by a dorsal mesentery, which either, as in *Oneirophanta*, *Lætmogone*, &c., consists of a continuous more or less fenestrated membrane, or, as in *Scotoplanes globosa*, &c., is reduced to bands and threads. The mesentery is usually strengthened by calcareous spicula of varying shape and size.

THE PSEUDHÆMAL SYSTEM.

The pseudhæmal system in the Elasipoda closely resembles that in the rest of the Holothurioidea; and this having been already most carefully described by Tiedemann, Semper, &c., does not require any further explanation. I only intend to point out some peculiarities, especially with regard to the arrangement of the vessels, which in a more or less important degree distinguish the order in question. However, it ought to be remembered that any closer examination of the hæmal system has not been possible because of the materials having been highly macerated and softened by long immersion in spirit.

The ventral and dorsal stems seem usually to consist of but a single vessel. None of the Elasipoda possessing any respiratory trees, no traces are discernible of the large *rete* *mirabile* which proceeds from the dorsal vessel in the Aspidochirotæ and Molpadidæ, and comes into relation with the left respiratory tree. In immediate relation to and seemingly grown together with the water-vascular ring is the annular plexus of the pseudhæmal vessels, which communicates by a larger branch with the reproductive organ. By means of injections I have not only succeeded in distinguishing most plainly the large main-vessels and their branches which are often most conspicuous in *Oneirophanta*, &c. (Pl. XL. fig. 2), but also a delicate plexus of very fine vessels inside the walls of the digestive tract (Pl. XL. fig. 1 and Pl. XXXVI. figs. 1, 2).

One or more transverse commissural vessels may always be found. *Oneirophanta mutabilis* possesses two such vessels, which connect the first descending and the ascending portions of the ventral main vessel with one another; one of these commissural vessels (Pl. XL. fig. 2, *e*) is comparatively long and crosses the other which is much shorter (Pl. XL. fig. 2, *f*), and which divides at both ends into several minute branches. In *Deima validum* the dorsal as well as the ventral stems carry commissural branches, the former one, and the latter two. The dorsal branch connects the first descending portion of the dorsal main vessel,—with which it is in communication by numerous small branches,—with the ascending portion of the same vessel. One of the ventral commissural branches runs out from the ventral vessel not far from the annular plexus and extends to the ascending portion of this vessel, while the shorter and thicker branch, proceeding a little behind the joint of the former, passes into the anterior curve of the ventral main vessel. Judging from what I have been able to observe in numerous species, a great variety seems to exist with regard to the size and position of these commissural vessels. The walls of the pseudhæmal system being often strengthened by numerous calcareous bodies of varying shape, the vessels themselves often become hard and brittle, as, for instance, in *Deima fastosum*; in this species these deposits have the form of large, close-lying, perforated plates of a highly variable appearance, which attain a length of from 0·60 mm. to 0·70 mm. (Pl. XXXV. figs. 7, 8). In *Lætmogone wyville-thomsoni*, &c., the vessels are on the contrary supported by scattered, spinose, branched or simple spicules (Pl. XXXVI. fig. 3).

THE AMBULACRAL SYSTEM.

The general presence of a more or less complicated system of ambulacral vessels is one of the most marked peculiarities of the Echinoderm type, and every contribution to the knowledge of that system of vessels ought to be of the greatest interest and value. The deep-sea Holothurids present an abundance of peculiarities, and their water-vascular system, remarkable in more than one respect, departs in many ways from what is supposed to characterise this class of animals.

The general characters of the water-vascular system of the Elasipoda do not differ essentially from those of the Pedata. There is always a circular canal which surrounds the gullet and sends forwards five "main canals" (Pl. XLIII. fig. 4, *k*), which divide into branches communicating with the tentacles, and give off five radial ambulacral vessels which run backwards along the longitudinal muscular bands, separating them from the ambulacral nerves. In my report on the genus *Elpidia*[1] I showed that this genus had only two radial ambulacral vessels, one along each side of the ventral surface. After that, Danielssen and Koren not only established the truth of my observations concerning *Elpidia*, but also asserted that their own new genera *Irpa* and *Kolga* had only two radial vessels. Having most carefully examined the rich material of partly enormous forms brought home by the Challenger Expedition, I am fully convinced that all the Elasipoda are provided with five radial ambulacral vessels. By injecting the odd ambulacral vessel, which is easily done in *Lætmogone*, *Oneirophanta*, *Scotoplanes globosa*, and in many other large forms, not only does the vessel in question become filled with colouring matter, but also the circular canal and its branches, and the same result is attained by filling the dorsal ambulacral vessels or their processes with some coloured liquid. Even by means of transverse sections of these ambulacra one can easily be convinced that these vessels are present in all forms which I have examined, and, consequently, even in *Elpidia glacialis* and *Kolga nana* (Pl. XLII. fig. 8). It must be admitted that I have had no opportunity to examine *Irpa abyssicola* and *Kolga hyalina* described by Danielssen and Koren, but it would be very singular if such closely allied forms should form exceptions to the rule.

Danielssen and Koren[2] are right in not agreeing with the opinion expressed by me concerning the lateral ventral ambulacral vessels of *Elpidia glacialis*. In fact, I succeeded no better in distinguishing the true lateral ventral vessels than the other vessels, for what I described as such are only the large very remarkable ambulacral vesicles or rather cavities which communicate with the pedicels, lie side by side and are closely united with one another, thus appearing like a large wide canal which runs along each side of the body and is divided by very thin double walls into cavities, corresponding to the pedicels in number. These partition walls were most strictly described by me, and the figures 4, 28 and 29 in my memoir on the *Elpidia* give a true idea of their appearance. The extremely narrow and fine ambulacral vessels which become distinguishable only in transverse sections, had escaped my attention. Thus, it is evident that the general arrangement of the water-vascular system in the Elasipoda corresponds to that in the Pedata.

The circular water-vessel, which in some forms, as, for instance, in *Oneirophanta*, *Deima*, *Orphnurgus*, &c., is very wide, but in others, as, for instance, in *Benthodytes sanguinolenta*, &c., seems to be comparatively much narrower, does not closely surround the gullet, but is attached to it by a great many filaments (Pl. XLIII. fig. 1), an interval being thus constituted, which connects the œsophageal sinus with the peritoneal cavity; when this communication exists as, for instance, in *Oneirophanta, Deima*, &c., the openings between the five main canals never appear closed, consequently, even here the sinus communicates with the peritoneal cavity. In *Benthodytes sanguinolenta, Lætmogone*, and many other forms where such a circular interval is present between the gullet and the circular water-vessel, the œsophageal sinus is closed by a very thin membrane which not only unites the five main vessels with one another, but is continued as a circular band lying close behind the circular vessel connecting this with the œsophagus (Pl. XL. fig. 5, *m*). Sometimes as in *Ilyodæmon maculatus*, &c., the circular water-vessel carries a great many very small cæcal sacs, the function of which is unknown. Most of the Elasipoda are provided with a single Polian vesicle, but in *Parelpidia elongata, Parelpidia cylindrica, Elpidia incerta, Elpidia willemoësi, Peniagone horrifer* and *Peniagone vitrea*, a couple of such cæcal prolongations of the circular water-vessel may be observed. These vesicles are always ventral in position, and when only one is present it lies to the left. In the family Elpidiidæ the Polian vesicle has a rounded form, and does not attain any considerable size, while in the two other families it is more elongated, almost cylindrical and often remarkably large. Its size varies most strikingly in different members of the same species, this being most apparent in *Oneirophanta;* one individual of this form dredged at Station 244 is remarkable for possessing a Polian vesicle, which measures about 134 mm. and is almost as long as the animal itself. Even *Orphnurgus asper* is distinguished by a Polian vesicle of unusual size. As a matter of fact, the number of Polian vesicles varies in a remarkable manner in the Pedata, but above all in the Apoda, though it must be remembered that even in these orders many forms have only a single one.

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[1] Kongl. Svenska. Vetenskaps Akademiens Handlingar, Bd. xiv. No. 8, Stockholm, 1877.

[2] Echinodermen fra den Norske Nordhavsexpedition (Nyt Magazin for Naturv., Bd. xxv. 2, Christiania, 1879).

The tubular prolongations of the circular water-vessel, which are termed the madreporic canal, always single in the Elasipoda, run in the medio-dorsal line, and are intimately attached to the interradial dorsal mesentery (Pl. XLIII. fig. 4, *a*, and fig. 6, *a*). It is very well known that in the other Holothurioidea, if, even as a rule, a single dorsal madreporic canal with a single terminal madreporic tubercle is present, many exceptions are to be found, which having been fully described in the splendid memoirs of Semper and Selenka do not require repetition here. For a long time it was considered as characteristic of all the Holothurioidea that the madreporic tubercle was always internally placed, consequently the interior of the ambulacral system could not communicate with the exterior, but only with the peritoneal cavity. As will be presently pointed out, many of the deep-sea Holothurids form exceptions in having the stone canal piercing the perisoma in the medio-dorsal line at greater or smaller distances from the crown of tentacles, thus bringing the water-vascular system in communication with the exterior as is the case in other Echinoderms. In Elasipoda two kinds of madreporic canals are apparent, and it is of importance to note carefully that their ends, even if they do not pierce the perisoma, are always closely united to and fused with the body-wall in the medio-dorsal line; no Elasipoda are found in which the madreporic canal depends freely into the peritoneal cavity or is attached only to the dorsal mesentery. In the following species the water-vascular system communicates with the exterior by one or several pores:—*Lætmogone wyville-thomsoni*, *L. violacea*, *L. spongiosa*, *Ilyodæmon maculatus*, *Achlyonice paradoxa*, *Scotoplanes globosa*, *S. papillosa*, *S. robusta*, *Kolga nana*, *K. hyalina*, *Parelpidia cylindrica*, *Elpidia purpurea*, *E. incerta*, *E. willemoësi*, *Peniagone wyvillii*, *P. vitrea*, *P. affinis*, *Benthodytes typica*, *B. abyssicola*, *Psychropotes longicauda*, and *P. semperiana*. I am fully convinced that only in a few forms, viz., *Oneirophanta mutabilis*, *Orphnurgus asper*, *Irpa abyssicola*, *Elpidia glacialis*, and *Benthodytes papillifera*, the madreporic canal does not open externally but is intimately united to the body-wall in its medio-dorsal line; concerning the rest of Elasipoda the material has been too scanty to allow of any satisfactory researches.

When examining that group of the Elasipoda in which the ambulacral system does not open externally, one finds that in most cases the madreporic canal terminates in a larger or smaller porous tubercle or plate, one side of which is closely united to the body-wall, while the other is free. In *Orphnurgus*, &c., the madreporic tubercle is divided by the mesentery into two halves, each being flat, slightly concave, and measuring about 4·5 mm. in length (Pl. XXXVIII. fig. 10). The size, form, and structure of this tubercle are highly variable in the different species. In *Orphnurgus* the network which composes it is of a very solid structure, the free surface being roughened by numerous calcareous papillæ. In *Oneirophanta* the tubercle is more convex but without the solid structure present in *Orphnurgus* (Pl. XXXVIII. figs. 11, 12), and in *Benthodytes papillifera* it has an almost globular shape. *Elpidia glacialis* has, on the contrary, no madreporic tubercle, —according to Danielssen and Koren traces of one are present in a thin very minute network,—and it appears that the terminal part of the stone canal ends cæcally within the body-wall.

In most forms where the water-vascular system is in communication with the exterior, the madreporic canal usually opens by one (Pl. XXXVIII. figs. 2 and 5) but not infrequently by several pores. Danielssen and Koren[1] were, some years ago, the first to describe, in their report on the Echinoderms dredged during the Norwegian North Atlantic Expeditions, a Holothurid, *Kolga hyalina*, which had the madreporic canal running out in a pore. At about the same time I observed the very same peculiarity in several of the Challenger Holothurioidea. The pore or pores always pierce the body-wall at the very place where, in the other Elasipoda, the madreporic tubercle joins the body-wall, that is, in the medio-dorsal line at a longer or shorter distance from the crown of tentacles, and close to the genital aperture. I intend to point out those cases in which several pores are to be seen.

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[1] Nyt Magazin for Naturvidenskaberne, Bd. xxv. 2, Christiania, 1879.

When examining the madreporic canal in *Lætmogone wyville-thomsoni* it will be found that, proceeding as usual from the dorsal part of the ambulacral ring, it runs upwards and backwards, being enveloped by the dorsal mesentery, and is attached at the medio-dorsal line about 30 mm. behind the tentacular crown (Pl. XLIII. fig. 4, *a*). The terminal part is surrounded and entirely enveloped by a rather thick layer of connective tissue, and gives off, four, five, or up to nine very fine branches, which pierce the body-wall, and open at the tops of small papillæ, 2 or 3 mm. long. These papillæ vary in position; they are either closely crowded in front of, or at one side of, or behind the large genital process, or they are situated in a semicircle along one side of the latter (Pl. XXXVIII. fig. 9, *a*). The fine canals, which pierce the perisoma, are rendered most distinct because of the great abundance of red and violet pigment present in their walls. A transverse section of the papillæ proves that they are made up of a very thick layer of connective tissue, containing a multitude of filaments, cells, and pigment, and that the canal which penetrates them is very narrow, scarcely a fifth of the diameter of the papillæ themselves.

In *Ilyodæmon maculatus* (Pl. XXXVIII. fig. 6) the terminal part of the madreporic canal divides into a greater or smaller number, sometimes up to fifty, branches, which penetrate the body-wall immediately in front of the genital process, and about 20 mm. behind the anterior extremity of the body. The fine canals, which do not run out in any papillæ, are often slightly expanded and branched, and contain a great quantity of pigment, but no deposits are present in them; their walls are extremely thin, and lined by an epithelium consisting of small, flat cells, which differ most strikingly from the elongated, closely-crowded, cylindrical cells, which line the true madreporic canal. In *Benthodytes abyssicola* the madreporic canal sometimes runs out by a single pore (Pl. XXXVIII. fig. 2, *a*), sometimes by four pores, which lie together at the top of a small obtuse papilla (Pl. XXXVIII. fig. 1). The canal is often more or less strengthened by calcareous deposits, but it may also lack such, as, for instance, in *Kolga hyalina*, Dan. and Kor. The fine canals or branches, which penetrate the body-wall seem to be always without calcareous matters.

The five main canals, which proceed from the circular vessel of the ambulacral system, are long and wide in some forms, and are always attached to the most anterior portion of the alimentary canal by numerous threads or filaments (Pl. XLIII. fig. 1, *a*). Their communication with the circular vessel is effected by means of a wide opening, while their anterior, slightly distended ends, lying close to the calcareous ring, open into the tentacles and the radial ambulacral vessels by a minute orifice. In *Deima fastosum* especially I have had the opportunity of observing the manner in which the main canals terminate in the tentacles and the ambulacral vessels. The anterior slightly distended end of these canals (Pl. XLIII. fig. 7, *a*) lies close to the posterior portion of the calcareous ring, to which it is closely united, and opens by a minute orifice into a very narrow duct, which lies close to the inwardly-directed side of the calcareous ring, and turning round the anterior portion of this latter, passes into the radial ambulacral vessel (Pl. XLIII. fig. 7, *y*). That part of the narrow duct which is situated at the inwardly-directed side of the calcareous ring, and which presents a small expansion, gives off two pairs of branches (Pl. XLIII. fig. 7, *c*) the posterior being longer than the anterior one; these branches are the true tentacular canals.

In *Oneirophanta* and *Deima*, &c., the tentacular cavities reach a considerable size, and are supported posteriorly by the calcareous ring (Pl. XLIII. fig. 1, *k*); anteriorly they pass into the branches or processes of the terminal part of the tentacles, but if there be no such, as in *Ilyodæmon maculatus*, *Lætmogone*, &c. (Pl. XXXIX. fig. 4, and Pl. XLIV. figs. 11 and 14), the water-vascular system gives off a number of branched or unbranched cæcal prolongations within the thick sole-like terminal part. The tentacles of the Elasipoda never possess ampullæ. The five radial ambulacral vessels, which run backwards along the longitudinal muscular bands, on the inner side of the ambulacral nerves, and which sometimes, as in *Lætmogone wyville-thomsoni*, reach a considerable width (Pl. XLII. fig. 1, *e*), commonly give off very short lateral branches which enter pedicels and processes; in some cases there are no such lateral branches present, but the pedicels and processes communicate directly by a minute aperture with the ambulacral system. A transverse section of an ambulacrum shows very distinctly that the radial ambulacral vessels are separated from the neural canal by a firm, apparently homogeneous elastic layer of connective tissue (Pl. XLII. fig. 9, *e*). It is rare to meet with Elasipods, in which exist true ampullæ, freely depending into the peritoneal cavity, notwithstanding which two kinds of such ampullæ may be observed—the simple and the branched. The simple ampullæ have been found only in *Ilyodæmon maculatus* (Pl. XLII. fig. 3), where they attain a considerable size, from 10 mm. to 15 mm., thus exceeding the Polian vesicle in size, and where they are only present in communication with the dorsal ambulacra. The branched ampullæ, which are met with in *Orphnurgus asper* (Pl. XLI. fig. 3, *b*), and *Pannychia moseleyi*, really belong to the processes and consist of small vesicles, which send out a number of very short, but comparatively wide cæcal prolongations. The pedicels appear regularly to lack such ampullæ, at least I did not find them, excepting, as in *Orphnurgus asper*, in communication with the large ambulacral cavities or rooms (Pl. XLI. fig. 3, *c*), which will be described further on.

Often no ampullæ nor anything corresponding to them can be discerned, and this seems to be especially the case in the Psychropotidæ, where, however, canals very commonly occur remarkable for their length and width, which lie within the perisoma and are in direct communication with the pedicels and processes. In this family the broad, flat, characteristic brim which surrounds the body is penetrated by a great many of these canals, very wide, lying side by side (Pl. XL. fig. 8, *b*); and these taper towards the margin of the brim and enter the often minute tuberculate pedicels or processes, which are situated in the margin. Special attention should be paid to the width of these canals, of which *Euphronides depressa* (Pl. XXXIX. fig. 1) affords a striking example, but at the same time it becomes evident that these canals are fully analogous to the lateral branches, which the radial ambulacral vessels in Pedata give off to the pedicels and processes.

A remarkable peculiarity in a great number of Elasipoda is the presence of large ambulacral cavities, which lie enclosed within the perisoma, and being in direct communication with the pedicels and processes should be regarded as only continuations of these. Two kinds of such cavities are present, the branched and the unbranched, the former being found in *Oneirophanta*, *Deima*, *Orphnurgus*, *Ilyodæmon*, and *Achlyonice*. In *Oneirophanta mutabilis* the lateral pedicels as well as the processes are in communication with large branched ambulacral cavities. The cavities which belong to the processes of the dorsal ambulacra are enclosed within the odd interambulacrum (Pl. XXXVI. fig. 4), and those communicating with the processes of the lateral ventral ambulacra lie within the lateral interambulacra, while those of the pedicels, principally belonging to the trivium, send out numerous branches into the lateral interambulacra (Pl. XLI. fig. 2, *g*). Each cavity resembles a flat room of considerable width which gives off in all directions branched and unbranched, longer and shorter cæcal prolongations (Pl. XLI. figs. 1, 2). Since the cavities of the lateral ventral ambulacra are closely crowded, the thick perisoma of each side of the body contains a very complicated system of cavities and canals. Here and there the radial ambulacral vessels seem to send out a larger or smaller cæcal prolongation, which does not communicate with any pedicels and processes (Pl. XLI. fig. 1, *e*).

As to the ambulacral cavities, *Deima* closely resembles the above-mentioned form. It has already been noted that true unbranched ampullæ are present in communication with the dorsal processes only in *Ilyodæmon maculatus*, while the pedicels of this species without ampullæ communicate with elongated cavities which run towards the medioventral line and terminate in some small branched and unbranched prolongations (Pl. XLII. fig. 4). But, even in *Orphnurgus*, *Achlyonice*, *Pannychia*, &c., plain evidence is given that the ambulacral cavities or vesicles of the processes do not always resemble those of the pedicels. In the first-mentioned genus all the processes are in communication with small branched ampullæ, while the pedicels proceed from somewhat large ambulacral cavities, which give off a small number of large, obtuse, slightly branched prolongations (Pl. XLI. fig. 3); it is, however, to be noted that these cavities send out a branched freely depending ampulla of the same appearance as that of the processes, though slightly smaller, thus constituting a combination of cavities and ampullæ. In *Achlyonice* the ambulacral cavities of the dorsal processes are small, oval, and unbranched (Pl. XLI.

fig. 5, *a*), while those of the pedicels having an elongated shape and being directed towards the middle line of the ventral surface are remarkable in that their blind end is slightly expanded and terminates in numerous, ten or more, cæcal branches. As above stated, the processes in *Pannychia* communicate with small branched vesicles, while the pedicels are provided with elongated ambulacral cavities.

The genus *Lætmogone* amongst the Deimatidæ (Pl. XLII. figs. 2 and 7), as well as most of the representatives of the Elpidiidæ (Pl. XLII. fig. 5, *c*, and Pl. XXXVI. figs. 5 and 6), are provided with unbranched ambulacral cavities, the form and appearance of which have already been demonstrated in the description of the species. The cavities, especially those belonging to the pedicels, seem in general to become elongated and tapered towards their cæcal end, which lies more or less close to the medio-ventral line, while their opposite portion, from which the pedicels proceed, often attains a considerable width; sometimes, as in *Lætmogone violacea*, *Scotoplanes globosa*, *Elpidia glacialis*, &c., this portion is so broad and wide that the cavities of the different pedicels become closely crowded side by side and separated from one another by a thin wall only (Pl. XLII. fig. 2, and Pl. XXXVI. fig. 5).

In the two known species of *Deima* a canal system is present which, as far as I know, does not exist in any other Holothurid. As may be remembered these two forms carry a great number of minute papillæ arranged in a single crown round the anterior aperture of the body (Pl. XLIII. fig. 2, *a*, and fig. 5, *a*), inside which the tentacles are situated. These papillæ, which are strengthened by small branched and perforated, irregular calcareous deposits, are in communication with fine canals (Pl. XLIII. fig. 5, *d*), which lie closely crowded side by side and are intimately united with one another, thus forming a continuous whole which closely surrounds the tentacular cavities. The canals being directed outwards and backwards, it has been possible to follow them as far as the neighbourhood of the most anterior part of the radial ambulacral vessels. The walls of the canals are made up of longitudinal fibres, and are supported by small, branched, scattered calcareous spicules. Along each of the canals a distinct nerve-branch is visible. There is no doubt that this system of canals is connected with the ambulacral system, and in *Deima validum* it appeared to me that this communication takes place just where the radial ambulacral vessels begin.

In some Elasipoda, as, for instance, in *Ilyodæmon maculatus*, &c. (Pl. XLII. fig. 3, *c*), larger or smaller cavities are present in the more or less thick perisoma, which cavities should be regarded as belonging to the water-vascular system. The walls of the ambulacral system frequently contain a varying quantity of calcareous deposits.

THE REPRODUCTIVE ORGANS.

In all the Elasipoda, without any known exceptions, the sexes are distinct, as is the case in the majority of the other Holothurioidea. Generally, the reproductive organs are more or less bilaterally symmetrical, consisting of two fascicles of longer or shorter, simple or dichotomously branched cæca, attached one on each side of the medio-dorsal mesentery. But in several representatives of the Elpidiidæ, as, for instance, *Elpidia glacialis*, *Scotoplanes globosa*, *Scotoplanes robusta*, *Achlyonice paradoxa*, &c., there is only a single fascicle to be seen. As to their general appearance the generative organs of this order present a great resemblance to those of the Dendrochirotæ and the Aspidochirotæ, the former having two fascicles, the latter, with a few exceptions, but a single one.

Concerning the form, number, and size of the cæca which compose the reproductive organs, there exists a great variation in the different species. The cæca of *Oneirophanta mutabilis* are always unbranched, being more numerous, narrower, and more regularly cylindrical in the males than in the females (Pl. XLVI. figs. 6, 7). *Deima fastosum* has the generative cæca, six to seven in each fascicle, unbranched and cylindrical, (Pl. XLVI. fig. 8), while the other species of the same genus has each fascicle made up of five to six elongated very slender tubes, bearing larger and smaller spherical cæcal branches (Pl. XLVI. fig. 5). The reproductive organs in *Euphronides depressa* are very remarkable, for each fascicle—in the largest specimen, about 125 mm. long—is reduced to a single tube, the posterior half of which is greatly distended so as to take the shape of an oval elongated sac, covered with tuberculate protuberances (Pl. XLVI. fig. 4). In most cases, however, the reproductive organs of the Elasipoda are formed after the same plan as those in other Holothurioidea, wherefore I refer to the description of the species instead of detailing their shape here.

But the genital glands of the different sexes do not always quite agree with one another, of which fact *Benthodytes abyssicola*, *B. sordida*, &c. (Pl. XLVI. figs. 9 and 10), afford striking examples, their male organs being composed of very numerous and minute dichotomously branched cæca, while the female organs are very thin, and made up of comparatively very few, large and voluminous, slightly dichotomous cæca.

The single efferent duct, attached to the medio-dorsal mesentery, passes forwards and always opens in the medio-dorsal line, its communication with the exterior being commonly at a rather considerable distance from the crown of tentacles. As a rule, the genital aperture is situated immediately in the body-wall, but it is not infrequently placed at the top of a genital process, which in *Lætmogone* and *Ilyodæmon* attains a considerable length (Pl. XLIII. fig. 4, *c*, and Pl. XXXVIII. figs. 6, 7, 9). In one individual of *Lætmogone wyville-thomsoni* I noticed that this genital process bore a small branch near its middle, and in another specimen the top itself was divided into four parts.

A transverse section of the genital process shows very distinctly that it is built up of a very thick, dense, almost cartilaginous layer of connective tissue, the canal itself being thus very narrow. At the base it may easily be observed that this layer is composed of three different layers; the outer, which is a continuation of the integument of the body-wall itself, is separated from the inner, which has a yellow colour, by a dense membranous layer, which is strengthened by some muscular elements and seems to include some small cavities.

As in all previously known Holothurids, the efferent duct is generally simple, but in some cases it may be observed that its end, when piercing the perisoma, gives off some very fine branches, each communicating with the surrounding medium by a pore. In *Elpidia purpurea* and *Peniagone vitrea* the efferent duct divides into two narrow divergent branches, which pass in opposite directions through the perisoma, and open externally, one on each side of the madreporic pore. In *Peniagone wyvillii* the efferent duct (Pl. XXXVII. fig. 6, *e*) is surrounded by the same thick and dense sheath of connective tissue which envelops the madreporic canal, and divides into two short, wide, and divergent canals, each of which, when the inside of the perisoma is reached, terminates in about eight long slender canals, which run within the perisoma, and communicate with the exterior by pores. These pores are scattered, not only over the anterior portion of the odd interambulacrum, but sparsely on the lateral interambulacra also.

The walls of the reproductive organs are often strengthened by calcareous deposits, which in some forms, as, for instance, *Deima fastosum*, &c., are very closely crowded, and covering one another, the walls thus becoming very hard and brittle. Having nothing of importance to add to the facts already known regarding the histological structure, I only refer to Plate XXXVII., which shows some sections of the reproductive organs.

General Remarks.

The most remarkable and distinguishing characteristic of the Elasipoda is their agreement in several important points, in their inner as well as their outer organisation, with the larval state, an agreement more close than occurs in any previously known Holothurid. The following characteristics are especially worthy of note as reminiscences of the development of the Holothurioidea :—

1. The strongly marked bilateral symmetry of the body and the fact that the highly convex dorsal surface is often extended further than the mouth, which thus becomes fully ventral in position.
2. The presence of pedicels on the ventral surface only, and their arrangement in pairs, but, above all, in the Elpidiidæ, their small number and their occasional position on the posterior part of the body only.
3. The simple shape of the calcareous deposits of the body-wall.
4. The simple conformation of the calcareous ring.
5. The communication of the water-vascular system with the exterior.
6. The absence of respiratory trees and ciliated cups.

Our present knowledge of the development of the higher Holothurids is rather unsatisfactory, and confined to that of a few forms. However, the development of *Holothuria tremula*, Gunner, *Holothuria tubulosa*, Gmelin, and *Cucumaria doliolum*, Grube, has been most carefully described by Joh. Müller,[1] Selenka,[2] Danielssen and Koren,[3] and Kovalewsky.[4] According to these authors the gastrula, as it grows larger, assumes a distinctly bilateral form; the ventral surface becomes more or less flattened or concave, the dorsal, on the contrary, convex, and the latter projects slightly beyond the mouth and terminates anteriorly, as in *Cucumaria doliolum*, in a rounded præ-oral prominence (Kopfkegel, according to Selenka). The mouth is thus fully ventral. As development advances, the larva loses more or less of its primitive bilaterality, and the mouth becomes more terminal in position. In fact, a bilateral symmetry is distinctly traceable even in many adult forms of shallow-water Holothurids, as, for instance, *Psolus*, *Colochirus*, and the Aspidochirotæ, but, as it seems to me, this bilaterality is nowhere so conspicuous as in the deep-water Holothurids in question. In many Elasipoda the convex dorsal surface projects further than the mouth, which is thus rendered thoroughly ventral in position. That portion of the back which lies in front of the mouth strikingly resemble the rounded præ-oral prominence of the larva of *Cucumaria doliolum*.

As a matter of fact, the first pedicels which become developed not only belong to the ventral surface, but are even disposed in pairs and situated near the posterior extremity of the larva. It is rather surprising to find numerous examples of deep-sea Holothurioidea, as, for instance, *Elpidia purpurea*, *Scotoplanes robusta*, most of the species of *Peniagone*, *Scotoanassa*, &c., which are provided with only a few pairs of pedicels, situated on the posterior part of the ventral surface, while the rest of that surface is completely devoid of pedicels. Moreover, the pedicels of the Elasipoda belong exclusively to the ventral surface, and are distinctly opposed across that surface so as to form pairs with each other. Thus it seems as if even with respect to the pedicels, the conformity between the larvæ and the adult in the Elasipoda is more striking than that which exists in the Apoda and the Pedata.

The simplest forms of calcareous deposits are spicules, and these also appear first in the body-wall of the larvæ of the Pedata, while it is a well known fact that the larvæ of the *Synapta* are provided with small wheel-shaped plates, which are evidently a much more complicated kind of deposit than the former. The perisoma of the Elasipoda, excepting *Deima* and *Oneirophanta*, is regularly strengthened by spicules and wheels, the former of which are far more common than the latter. Thus it must, I think, be admitted that the Elasipoda present a singular resemblance to the larval forms as to their calcareous deposits, these having remained at such a low degree of development. As a matter of fact, simple unbranched spicules alone are found in several species, but spicules with three or four arms

[1] Abhandlungen d. Königl. Akad. d. Wissenschaften zu Berlin, 1846–1854.

[2] Zur Entwickelung der Holothurien (*Holothuria tubulosa* and *Cucumaria doliolum*), (Zeitschrift für wissenschaftliche Zoologie, xxvii., 1876, pp. 155–179, pls. ix.–xiii.).

[3] Bidrag til Holothuriernes udviklingshistorie (Fauna littoralis Norvegiæ, ii., 1856. pp. 47–54, pls. vii., viii.).

[4] Entwickelungsgeschichte der Holothurien (Mémoires de l'Acad. imp. d. Sc. de St. Pétersbourg, vii. série, tom. xi., No. 6, 1867, pp. 1–8, pl. i.).

are by far most commonly seen in the deep-water Holothurioidea in question. Supposing that the four arms of these deposits, instead of being free and independent, were connected at their ends with one another, each spicule would give origin to a plate with four holes, representing the first stage in the development of a plate or wheel. The process by which the plates and wheels of Elasipoda are developed from a spicule has been already sufficiently explained in the foregoing anatomical description. Besides, I may be justified in comparing the wheels of the Elasipoda with those of the larva of *Synapta*, but, as they are constructed in a different manner, the resemblance which they present is more apparent than real. In fact, all the wheels of the Elasipoda have the nave perforated by a large hole, from the edge of which rises a crown of four to six arcuate rods, while, on the contrary, the wheels of the larva of *Synapta*, in conformity with those of other Apoda, as, for instance, *Chirodota*, *Trochoderma*, and *Myriotrochus*, are devoid of a central hole as well as of a crown. The only exception to this rule occurs in the very strange minute hat-shaped bodies in *Elpidia glacialis*, which, however, by possessing a central crown composed of three rods, seem to approach more nearly to the wheels of the Elasipoda[1] than to those of the Apoda.

According to Müller, Baur,[2] Metschnikoff,[3] &c., the first traces of a calcareous ring in the larvæ appear as separate unbranched spicules surrounding the œsophagus. As the spicules grow larger, their ends become bipartite and gradually dichotomous ; finally, the spicules become connected with one another so as to form a complete ring. On comparing the larval ring with that of the Elasipoda, some very singular similarities present themselves. In fact, the whole family Elpidiidæ is distinguished by possessing a calcareous ring composed of spicules, which strikingly remind one of those of the larvæ, excepting that the branches or arms, which radiate from their ends, are more outgrown. However, it is of importance to remember that the ring is made up of only five radial pieces, while the larvæ, as it seems, have commonly ten, five radial and five interradial, the former five being probably first developed. The five spicules of the Elasipoda being, with a few exceptions, separated from one another, the resemblance becomes more striking. In the Deimatidæ the ring is in a somewhat more advanced state of development, the spicules having been converted into a fragile spongy network.

The larvæ of the Apoda and Pedata always have the madreporic canal in communication with the surrounding medium by an opening on the dorsal surface, but eventually the canal loses its connection with the exterior so as to hang loosely in the peritoneal cavity of the adult animal. Most of the Elasipoda are remarkable in having the water-vascular system in persistent communication with the exterior, thus obviously resembling the larval state. In the rest of the species, the madreporic canal neither opens externally by a pore, nor does it hang freely into the interior, but its end is intimately joined to the dorsal perisoma and is sometimes, as it were, blind and inserted in it. This must, of course, be considered as a transitional state between the larva and the fully-developed animal. Not long ago Ludwig[1] published an account of a young *Chirodota rotifera*, Pourtalès, in which the madreporic canal had begun to detach itself from the dorsal body-wall; it had already lost its pore on the exterior, and the blind end was enclosed within the perisoma.

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[1] In my memoir on the *Elpidia glacialis* I also described some large wheels which differ most strikingly in shape from those of other Elasipoda, and present the greatest resemblance to those occurring in the Apoda. Danielssen and Koren are doubtless right in supposing that these wheels had accidentally stuck to the rough surface of the integument, and I feel the more convinced of it as I could never find them in more than one single individual.

[2] Beiträge zur Naturgeschichte der *Synapta digitata*, ii., Dresden, 1864, pp. 36, 37.

[3] Studien über die Entwickelung der Echinodermen und Nemertinen (Mémoires de l'Acad. imp. d. Sc. de St Pétersbourg, vii. série, tom. xiv., No. 8, 1869, pp. 6, 7, pl. i. fig. 11).

The respiratory trees and ciliated cups become developed only in a more advanced condition of the larvæ. Thus it seems to me as if the persistent absence of such organs in the Elasipoda indicated a certain conformity to the earlier stages of the Holothurids.

It follows from the facts above mentioned that the Elasipoda have retained many peculiarities characteristic of the larvæ of the Apoda and Pedata, and consequently that they have in many respects persisted without any sensible change for very long periods of time, and that they do not bear any genetic relation to the present representatives of the Apoda and Pedata, but are derived from ancestral forms of extreme antiquity.

On comparing the organisation of the recent Holothurioidea—the Elasipoda as well as the Apoda and Pedata—in the different stages of their development, and considering that the development of the embryo records the ancestral history of the species, it seems highly probable that the common progenitors of the three orders of Holothurioidea were characterised by a more or less distinctly-marked bilateral form, by a water-vascular system composed of a circular vessel, tentacular canals and a madreporic canal communicating with the exterior, by a calcareous ring, composed of spicules separated from one another, and by the absence of respiratory trees and ciliated cups, &c.

Danielssen and Koren[2] insist on the Elasipoda being placed very low in the series of Holothurids, but in this I cannot quite agree with them. The presence of a well-developed ambulacral system with five radial ambulacral vessels in connection with pedicels is considered as a marked peculiarity of the Echinoderm type; besides, in the more typical Echinoderms, as, for instance, the Echinoidea and Asteridea, &c., the madreporic canal terminates beneath a part of the apical system of ossicles, the pores of which place the ambulacral system in communication with the exterior. Now, it seems to me to be rather evident that those Holothurids must be regarded as higher in the Echinoderm chain, in which the water-vascular system has attained a higher degree of development, and there is no doubt, indeed, that the Elasipoda as well as the Pedata approach much nearer in this respect than the Apoda to the typical Echinoderms. I cannot conceive how the fact that the Elasipoda have retained more larval characteristics than the Apoda can in any way subvert this opinion. Lastly, concerning the mutual position of the Elasipoda and the Pedata, the former certainly are in one respect more nearly related to the typical Echinoderms than are the latter, viz., by their madreporic canal often communicating with the exterior, and that too not only by one pore but sometimes by a great number of pores crowded close together so as to form a kind of exterior "madreporic tubercle," but this peculiarity alone does not seem to me to decide their relative position. No doubt, the Pedata have, on the other hand, many important characteristics which may entitle them to a higher place in the series of Echinoderms.

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[1] Ueber eine lebendiggebärende Synaptide (Archives de Biologie, ii. 1881, pp. 41–56, pl. iii.).

[2] Echinodermer fra den Norske Nordhavsexpedition (Nyt Magazin for Naturvidenskaberne, xxv. 2, 1879, pp. 102–104).

But disregarding their position as Echinoderms, and considering only their general development as animals, I cannot but think that the Elasipoda have already in certain respects attained a higher development than all the other Echinoderms, and that this development is gradually advancing in a direction approaching the higher classes of animals. This opinion is founded on the following reasons:—

1. The form of the body is distinctly bilaterally symmetrical, with the ventral and dorsal surfaces clearly distinguishable from each other, with the mouth on the ventral surface and often with a head-portion plainly marked off from the rest of the body.

2. The ambulacral appendages of the ventral surface alone are intended for locomotion, these being in the typical Elasipoda particularly large and arranged on each side of the body in a single row; and the locomotive organs of the one side are accurately opposed to those of the other side so as to form distinct pairs, almost recalling the legs of an insect or the locomotory organs of one of the Polychœta, &c.

3. These locomotory organs show the most evident tendency to appear in fixed places and in a fixed number in every species of the more typical Elasipoda, and that their number is often rather limited, as, for instance, in *Elpidia glacialis*, which has always four pairs of pedicels, *Scotoplanes globosa*, which has five pairs, &c.

4. The dorsal appendages are so modified as to perform functions far different from those of the ventral appendages.

5. These dorsal appendages, like the ventral ones, have a tendency to become fixed in number so that every species may have a certain number situated in a certain place on the back.

EXPLANATIONS OF THE PLATES.

PLATE I.

Parelpidia cylindrica, n. sp.

Fig. 1. Dorsal view; natural size.
„ 2. Ventral view; natural size.

Parelpidia elongata, Théel.

„ 3. Dorsal view; natural size.
„ 4. Ventral view; natural size.

PLATE II.

Scotoplanes mollis, Théel.

Fig. 1. Dorsal view; natural size.
„ 2. Ventral view; natural size.

Kolga nana, Théel.

„ 3. Dorsal view; twice the natural size.
„ 4. Ventral view; twice the natural size.

Scotoplanes papillosa, Théel.

„ 5. Dorsal view; natural size.
„ 6. Ventral view; natural size.

PLATE III.

Elpidia verrucosa, Théel.

Fig. 1. Dorsal view; one and a half times the natural size. *a*, holes after the dorsal processes, which are broken off.
„ 2. Ventral view; one and a half times the natural size.

Scotoplanes murrayi, Théel.

„ 3. Dorsal view; about four times the natural size.
„ 4. Ventral view; about four times the natural size.

PLATE IV.

Scotoplanes globosa, Théel.

Fig. 1. Dorsal view; natural size.
„ 2. Ventral view; natural size.

PLATE V.

Achlyonice paradoxa, Théel.

Fig. 1. Dorsal view; natural size.
„ 2. Ventral view; natural size.

Scotoplanes globosa, Théel.

„ 3. Side view; natural size.

PLATE VI.

Scotoplanes robusta, n. sp.

Fig. 1. Side view; natural size.
„ 2. Dorsal view; natural size.
„ 3. Ventral view; natural size.

PLATE VII.

Scotoplanes insignis, n. sp.

Fig. 1. Dorsal view; natural size.
„ 2. Side view; natural size.
„ 3. Ventral view; natural size.

Elpidia purpurea, n. sp.

„ 4. Dorsal view; natural size.
„ 5. Side view; natural size.
„ 6. Ventral view; natural size.

Peniagone vitrea, n. sp.

„ 7. Dorsal view; one and a fifth the natural size.
„ 8. Side view; one and a fifth the natural size.
„ 9. Ventral view; one and a fifth the natural size.

PLATE VIII.

Elpidia incerta, n. sp.

Fig. 1. Side view; natural size.

Elpidia willemoësi, n. sp.

Fig. 2. Side view; natural size.
„ 3. Ventral view; natural size.

Peniagone affinis, n. sp.

„ 4. Ventral view; natural size.
„ 5. Dorsal view; natural size.

Enypniastes eximia, n. sp.

„ 6. Ventral view; natural size. *b*, the anterior brim or appendage; *m*, mouth; *t*, tentacles.
„ 7. Dorsal view; natural size. *a*, anus; *b*, the anterior brim or appendage, which is penetrated by a number of wide canals lying side by side.

(Owing to the highly macerated materials, the figures of this animal are most defective).

Psycheotrephes[1] *exigua*, n. sp.

Fig. 8. Ventral view; twice the natural size.

PLATE IX.

Peniagone naresi, n. sp.

Fig. 1. Side view; natural size. *a*, the left dorsal ambulacrum, giving off branches to the large appendage.
„ 2. Ventral view; natural size.

(The posterior portion of the only individual I have seen is torn off, wherefore the figures are defective).

Scotoanassa diaphana, n. sp.

Fig. 3. Ventral view; natural size. *a*, the anterior brim; *b*, the posterior brim with the pedicels in its margin.
„ 4. Side view; natural size.
„ 5. Dorsal view; natural size.

Peniagone challengeri, n. sp.

„ 6. Ventral view; natural size.
„ 7. Side view; natural size.
„ 8. Dorsal view; natural size.

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[1] This seems a more correct name than *Psychotrephos*, used on the plate.

PLATE X.

Peniagone lugubris, n. sp.

Fig. 1. Side view; natural size.

Peniagone horrifer, n. sp.

„ 2. Side view; natural size.

Peniagone wyvillii, n. sp.

„ 3. Ventral view; natural size.
„ 4. Side view; natural size.

Peniagone atrox, n. sp.

„ 5. Side view; natural size. *a*, the brim-like fold on the left side of the dorsal surface.

All the animals which are figured on this plate are highly macerated and deformed by long immersion in spirits, consequently I am not quite sure of the correctness of my idea of their true shape.

PLATE XI.

Lætmogone wyville-thomsoni, Théel.

Fig. 1. Side view; natural size. *a*, genital process.

PLATE XII.

Lætmogone wyville-thomsoni, Théel.

Fig. 1. Dorsal view; two-thirds the natural size. *g*, genital process.
„ 2. Ventral view; two-thirds the natural size.

PLATE XIII.

Lætmogone violacea, Théel.

Fig. 1. Side view; natural size.
„ 2. Ventral view; natural size.
„ 3. Dorsal view; natural size.

PLATE XIV.

Lætmogone spongiosa, Théel.

Fig. 1. Side view; natural size.
„ 2. Dorsal view; natural size.
„ 3. Ventral view; natural size.

PLATE XV.

Orphnurgus asper, Théel.

Fig. 1. Ventral view; natural size.
„ 2. Dorsal view; natural size.

PLATE XVI.

Ilyodæmon maculatus, Théel.

Fig. 1. Side view; natural size.
„ 2. Dorsal view; natural size. *a*, anus; *b*, the space where the pores of the madreporic canal are situated; *c*, genital process.
„ 3. Ventral view; natural size.

PLATE XVII.

Pannychia moseleyi, n. sp.

Fig. 1. Ventral view; natural size.
„ 2. Dorsal view; natural size.

PLATE XVIII.

Deima validum, Théel.

Fig. 1. Side view; natural size.

PLATE XIX.

Deima validum, Théel.

Fig. 1. Dorsal view; two-thirds the natural size.
„ 2. Ventral view; two-thirds the natural size. *a*, the anterior aperture closed and encircled internally by the tentacles; *b*, anal aperture.

PLATE XX.

Deima fastosum, Théel.

Fig. 1. Dorsal view; natural size.
„ 2. Ventral view; natural size. *m*, the anterior aperture closed, inside which the tentacles are situated; *a*, anus.

PLATE XXI.

Deima fastosum, Théel.

Fig. 1. Side view; natural size.

Oneirophanta mutabilis, Théel.

„ 2. Side view; natural size.

PLATE XXII.

Oneirophanta mutabilis, Théel.

Fig. 1. Dorsal view; natural size.

„ 2. Ventral view; natural size. *a*, anal aperture.

„ 3. Ventral view of a smaller individual; natural size. *x*, Stylifer infested the ventral perisoma.

PLATE XXIII.

Benthodytes sanguinolenta, n. sp.

Fig. 1. Ventral view; natural size.

PLATE XXIV.

Benthodytes sordida, n. sp.

Fig. 1. Ventral view; natural size.

„ 2. Dorsal view; natural size.

PLATE XXV.

Benthodytes mamillifera, n. sp.

Fig. 1. Dorsal view; natural size.

Benthodytes sanguinolenta, var. *marginata*, n. sp.

„ 2. Ventral view; natural size.

PLATE XXVI.

Euphronides depressa, n. sp.

Fig. 1. Dorsal view; three-fourths the natural size.

„ 2. Ventral view; three-fourths the natural size.

PLATE XXVII.

Psychropotes longicauda, n. sp.

Fig. 1. Side view; natural size.

Psychropotes lovéni, n. sp.

„ 2. Ventral view; natural size.

„ 3. Side view; natural size.

„ 4. Dorsal view; natural size.

Benthodytes selenkiana, n. sp.

„ 5. Ventral view; natural size.

„ 6. Dorsal view; natural size.

Benthodytes typica, n. sp.

Fig. 7. Ventral view; slightly magnified.

PLATE XXVIII.

Psychropotes longicauda, n. sp.

Fig. 1. Ventral view; natural size.
„ 2. Dorsal view; natural size.

PLATE XXIX.

Pscyhropotes longicauda, var. *fusco-purpurea*, n.

Fig. 1. Side view; natural size.

Psychropotes longicauda, var. *monstrosa*, n.

„ 2. Side view; natural size.

PLATE XXX.

Psychropotes longicauda, var. *monstrosa*, n.

Fig. 1. Ventral view; natural size.

PLATE XXXI.

Oneirophanta mutabilis, Théel.

Fig. 1. Diverse forms of calcareous plates from the body-wall; diameter of the largest ones 2·2 mm.
„ 2. Calcareous rods from the dorsal processes.
„ 3. Spicula from the pedicels.

Deima validum, Théel.

„ 4. Calcareous plate from the body-wall; diameter 7 mm.
„ 5. A piece of the same plate highly magnified, showing two distinct layers.
„ 6. The outlines of several smaller plates from the body-wall.
„ 7. Spicula from the ends of the pedicels.
„ 8. Spicula from the layer of connective tissue of the body-wall outside the plates.
„ 9. Net-shaped body from the connective tissue of the body-wall inside the plates

Deima fastosum, Théel.

„ 10. A large plate from the body-wall, surrounded by a number of smaller ones exposed *in situ*; diameter of the largest one 5 mm.
„ 11. A piece of a plate highly magnified, showing several distinct layers.
„ 12. Spicula from the ends of the pedicels.
„ 13. Spicula from the tentacles.

Lætmogone wyville-thomsoni, Théel.

Fig. 14. Large wheel, seen from above; diameter about 0·14 mm.
„ 15. Small wheel, seen from above; diameter 0·04 mm.
„ 16. Spicula from the ventral perisoma; length about 0·38 mm.

PLATE XXXII.

Pannychia moseleyi, n. sp.

Fig. 1. Large wheel, from above; diameter 0·24 mm.
„ 2. The second stage in the devolpment of a large wheel, presenting the four-armed crown already formed; the ends of the arms are connected with one another so as to give rise to a ring which becomes the nave.
„ 3. The first stage in the development of a large wheel, showing a four-armed spiculum, the arms of which grow larger and constitute the crown.
„ 4. A later stage in the development of a large wheel, showing the nave nearly fully developed; the spokes are indicated by a series of outgrowths or processes round the margin of the nave. The space enclosed by the dotted lines marks a thicker portion, which is the centre of the growth of the nave, and which doubtless is the original ring formed by the arms of the crown which are being linked together.
„ 5. Small wheel-shaped plate; diameter 0·052 mm.
„ 6. The central part of a large wheel, from above, showing that the large central hole is covered with a very thin calcareous membrane, pierced by six minute holes; the dotted lines mark the crown composed of six arms, seen through the thin membrane just mentioned.
„ 7. Perforated plate from the dorsal processes; diameter 0·092 mm.
„ 8. Irregular, perforated plate from the ends of the dorsal processes; diameter 0·092 mm.
„ 9. Spicula from the ends of the dorsal processes.
„ 10. Spicula from the tentacles.
„ 11. Calcareous terminal plate from the ends of the pedicels.
„ 12. Irregular net-shaped bodies, lying outside the former and evidently formed by outgrowths of small wheel-shaped plates, which gradually change their original form so that they finally vanish.
„ 13. Calcareous network form the madreporic canal.

Scotoplanes albida, n. sp.

„ 14. Straight, spinous spiculum measuring about 0·57 mm.; and C-shaped bodies from 0·056 mm. to 0·1 mm. in length.
„ 15. Spicula from the pedicels.

Parelpidia elongata, Théel.

Fig. 16. Four-armed deposits from the body-wall; the arms about 0·12 mm. long.
„ 17. Spicula from the pedicels.

Elpidia rigida, n. sp.

„ 18. Four-armed deposits from the body-wall; the arms about 0·48 mm. long.
„ 19. Spicula and four-armed deposits from the pedicels.
„ 20. Deposits from the tentacles.

Achlyonice lactea, n. sp.

„ 21. Three-armed deposits with the longest arms about 0·22 mm.; and a small wheel measuring 0·06 mm. in diameter. Taken from the dorsal perisoma.
„ 22. Deposits from the ventral perisoma.
„ 23. Spicula from the pedicels.

PLATE XXXIII.

Kolga nana, Théel.

Fig. 1. Deposits from the body-wall, about 0·08 mm. long.
„ 2. Spicula from the pedicels.

Elpidia incerta, n. sp.

„ 3. Four-armed deposits from the body-wall, with the arms from 0·06 mm. to 0·16 mm.
„ 4. Deposits from the pedicels.

Peniagone atrox, n. sp.

„ 5. Larger and smaller four-armed deposits from the body-wall; the arms of the largest deposits 0·12 mm. long.

Elpidia ambigua, n. sp.

„ 6. Four-armed deposit with the arms 0·18 mm. long, and wheel, measuring 0·048 mm. in diameter.

Scotoplanes insignis, n. sp.

„ 7. Three-armed deposit and C-shaped bodies; the arms of the former 0·24 mm. long, and the latter measuring about 0·1 mm. in length.

Peniagone horrifer, n. sp.

„ 8. Deposits from the pedicels.
„ 9. Four-armed deposits from the body-wall, with the arms about 0·06 mm. long.

Elpidia willemoësi, n. sp.

Fig. 10. Four-armed deposits with the arms from 0·08 mm. to 0·22 in length.
„ 11. Deposits from the tentacles.
„ 12. Deposits from the pedicels.

Elpidia purpurea, n. sp.

„ 13. Four-armed deposits from the body-wall; the arms of the largest deposits about 0·1 mm. long.
„ 14. Deposits from the tentacles.

Peniagone naresi, n. sp.

„ 15. Unbranched or irregularly branched spicula, three-armed bodies with the arms from 0·06 mm. to 0·22 mm., and C-shaped deposits measuring in length about 0·068 mm.

Peniagone challengeri, n. sp.

„ 16. Four-armed deposits of various dimensions, the largest having the arms 0·2 or 0·3 mm. long.

Scotoplanes mollis, Théel.

„ 17. C-shaped bodies, about 0·12 mm. long.

PLATE XXXIV.

Lætmogone wyville-thomsoni, Théel.

Fig. 1. Terminal plates from the ends of the pedicels.

Scotoplanes murrayi, Théel.

„ 2. Spicula and C-shaped bodies from the body-wall; the former about 0·6 mm. and the latter about 0·12 mm. in length.

Elpidia verrucosa, Théel.

„ 3. Four-armed deposits from the body-wall, with arms about 0·5 mm. long.
„ 4. Deposits from the pedicels.

Kolga nana, Théel.

„ 5. Straight and horse-shoe-shaped spicula, and a net-shaped plate.

Scotoplanes robusta, n. sp.

„ 6. Three-armed body with the arms about 0·24 mm. in length, and C-shaped ones about 0·1 mm. long.
„ 7. Deposits from the pedicels and tentacles.

Scotoplanes globosa, Théel.

Fig. 8. C-shaped spicula, the largest 0·16 mm. long.

„ 9. Straight spicula, the largest about 0·92 mm. long.

Psychropotes semperiana, n. sp.

„ 10. Three, four and five-armed deposits from the back with the arms from 0·06 mm. to 0·16 mm. in length.

„ 11. Deposits from the ventral surface.

Peniagone affinis, n. sp.

„ 12. Four-armed deposits from the ventral perisoma, with the arms about 0·14 mm.

„ 13. Four-armed deposits from the dorsal perisoma, with the arms about 0·28 mm. in length.

Benthodytes papillifera, n. sp.

„ 14. Spicula, 0·44 mm. long, from the dorsal perisoma.

Orphnurgus asper, Théel.

„ 15. Spicula from 0·14 to 0·2 mm. long, from the body-wall.

„ 16. Spicula from the pedicels.

Peniagone vitrea, n. sp.

„ 17. Four-armed deposits from the body-wall, with the arms 0·16 mm. long.

„ 18. Deposits from the oral-disk.

PLATE XXXV.

Psychropotes loveni, n. sp.

Fig. 1. Four-armed deposits from the ventral perisoma, with the arms about 0·13 mm. long.

„ 2. Four-armed deposits from the outer layer of the dorsal integument, with the arms about 0·26 mm. long.

„ 3. Four-armed deposits from the inner layer of the dorsal integument, with the arms about 0·18 mm. long.

Benthodytes typica, n. sp.

„ 4. Spicula from the body-wall.

Euphronides depressa, n. sp.

„ 5. Four-armed deposits from the dorsal perisoma, the largest having the arm about 0·24 mm. long.

„ 6. Deposits from the ventral perisoma.

Deima fastosum, Théel.

Fig. 7. Deposits from the pseudhæmal vessels, which accompany the intestine.
„ 8. Deposits from the free connecting stems of the pseudhæmal system.
„ 9. Deposits from the walls of the reproductive organs.
„ 10. Deposits from the walls of the alimentary canal.

Psychropotes longicauda, var. *fusco-purpurea*, n.

„ 11. Four-armed deposits, with the arms about 0·3 mm. long.

Psycheotrephes exigua, n. sp.

„ 12. Four-armed deposits, with the arms about 0·1 mm. long.

Psychropotes longicauda, n. sp.

„ 13. Four-armed deposits from the outer layer of the dorsal integument, the arms from 0·06 mm. to 0·4 mm. long.
„ 14. Four-armed deposits from the inner layer of the dorsal integument.
„ 15. Deposits from the tentacles.
„ 16. Deposits from the ventral body-wall; the arms from 0·08 mm. to 0·24 mm. long.
„ 17. Deposits from the pedicels.

Scotoanassa diaphana, n. sp.

„ 18. Four-armed deposits, with the arms up to 0·016 mm. long.

PLATE XXXVI.

Oneirophanta mutabilis, Théel.

Fig. 1. Longitudinal section of the hindmost portion of the œsophagus and of the foremost part of the intestine. *a*, epithelium; *b*, outer layer of connective tissue; *c*, circular muscular layer; *d*, longitudinal muscular layer; *e*, inner layer of connective tissue; *f*, layer of glands; *g*, epithelium; *h*, pseudhæmal vessels; *v*, valve on the transition between the œsophagus and the intestine.[1]
„ 2. Transverse section of the intestine and the ventral pseudhæmal stem which accompanies it. *a*, epithelium; *b*, outer layer of connective tissue; *c*, circular muscular layer; *d*, longitudinal muscular layer; *e*, inner layer of connective tissue; *f*, layer of glands; *g*, epithelium; *h*, pseudhæmal vessels within the walls of the intestine; *i*, the ventral pseudhæmal stem; *k*, epithelium; *l*, circular muscular layer; *m*, layer of connective tissue; *n*, inner epithelium.

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[1] Where no measurements are given, the figures are more or less strongly magnified.

Lætmogone wyville-thomsoni, Théel.

Fig. 3. Deposits from the pseudhæmal vessels.

Deima validum, Théel.

4. Diagram exhibiting the relation of the dorsal and ventral surfaces and the position of the processes and pedicels. *a*, dorsal surface ; *b*, ventral surface.

Scotoplanes globosa, Théel.

5. View of the ambulacral cavities of the pedicels, seen from the peritoneal cavity. *a*, ambulacral cavities ; *b*, one of the lateral ambulacra ; *c*, openings into the pedicels ; *x*, communication between the ambulacral cavities and the ambulacral canal. Natural size.

,, 6. View of the ambulacral cavities of the foremost pair of dorsal processes, seen from the peritoneal cavity. *a*, ambulacral cavities ; *b*, the dorsal ambulacra ; *c*, openings into the dorsal processes. Natural size.

Deima fastosum, Théel.

,, 7. Calcareous deposits from the system of fine canals which are in connection with the minute papillæ which surround the anterior aperture of the body.

Oneirophanta mutabilis, Théel.

,, 8. A minute sheath with structureless contents and without any traces of calcareous deposits ; length about 0·08 mm. *a*, cells.

,, 9. Slightly larger sheath without calcareous matters.

,, 10. Sheath 0·20 mm. long. *a*, cells ; *b*, the contents with traces of concentric structure at the centre of the sheath ; *c*, a minute calcareous body in the centre of the sheath.

,, 11. Another slightly larger sheath. *c*, calcareous bodies. All these four stages of development of spicula are taken from a very minute pedicel of a very young individual from Station 146.

Ilyodæmon maculatus, Théel.

,, 12. A later stage of development of a large wheel, seen from below.

,, 13. An early stage of development of a large wheel, seen from below.

,, 14. A slightly more advanced stage of development of a large wheel ; seen from below.

,, 15. A fully developed large wheel, seen from above ; diameter from 0·14 mm. to 0·2 mm.

,, 16. Deposits within the water-vascular system.

,, 17. Small wheel, seen from above ; diameter about 0·028 mm.

,, 18. Dichotomously branched body of about the same size as the small wheels.

,, 19. Spicula from the pedicels.

Lætmogone violacea, Théel.

Fig. 20. Side view of a large wheel; diameter about 0·2 mm.
„ 21. Cruciform bodies from 0·072 mm. to 0·2 mm. in diameter.
„ 22. Spicula from the pedicels.
„ 23. Spicula from the tentacles.
„ 24. Spiculum from the ventral perisoma; length about 0·16 mm.

Kolga nana, Théel.

„ 25. Otolith; length about 0·028 mm.

Benthodytes abyssicola, n. sp.

„ 26. The sheath of a four-armed deposit, the calcareous substances being dissolved; the arms about 0·5 mm. long.
„ 27. Minute bodies within the integument.

PLATE XXXVII.

Elpidia willemoësi, n. sp.

Fig. 1. One of the five pieces or spicula which compose the calcareous ring.

Parelpidia elongata, Théel.

„ 2. One of the five pieces or rather spicula which compose the calcareous ring.

Deima fastosum, Théel.

„ 3. A portion of the calcareous ring. *a*, notch for the passage of the ambulacral nerves, &c.

Oneirophanta mutabilis, Théel.

„ 4. Side view of a portion of the calcareous ring. *a*, radial piece; *b*, interradial pieces; *x*, notch for the ambulacral nerves, &c.

Lætmogone wyville-thomsoni, Théel.

„ 5. Genital process with four tops.

Peniagone wyvillii, n. sp.

„ 6. A piece of the dorsal body-wall seen from the inner side, showing the foremost parts of the dorsal ambulacra and the terminations of the madreporic canal and the reproductive organs. *a*, perisoma near the tentacles; *b*, that part of the perisoma which is more distant from the tentacles; *c*, dorsal nerve stems; *d*, dorsal radial ambulacral vessels and dorsal longitudinal muscular bands; *e*, common efferent duct of the reproductive organs, which divides into two canals, each of which gives off a number of long and very slender branches; *f*, the madreporic canal enveloped by the same thick sheath of connective tissue, which surrounds the common duct of the genital organs; *x*, pores of the fine branches of the genital organs.

Lætmogone wyville-thomsoni, Théel.

Fig. 7. Transverse section of a follicle of the male reproductive organs, showing a series of longitudinal folds. *a*, epithelium; *b*, circular muscular fibres; *c*, layer of connective tissue with the epithelial lining.

Deima validum, Théel.

„ 8. Transverse section of a dorsal process. *a*, outer layer of connective tissue covered with an epithelium; *b*, inner layer of connective tissue; *m*, nerve fibres; *n*, the large nerve branch; *o*, inner covering.

Scotoplanes robusta, n. sp.

„ 9. One of the five pieces which compose the calcareous ring.

Psychropotes longicauda, n. sp.

„ 10. Diagrammatic view of a transverse section of the large dorsal appendage; twice the natural size. *a*, the canals which communicate with the dorsal ambulacra; *b*, nerves; *c*, connective tissue.

Lætmogone wyville-thomsoni, Théel.

„ 11. The calcareous ring viewed from above and from behind; twice the natural size. *x*, the ambulacral canals and nerves.

Scotoplanes papillosa, Théel.

„ 12. One of the five pieces which compose the calcareous ring.

Oneirophanta mutabilis, Théel.

„ 13. View of a transverse section of a follicle of the female reproductive organs. *x*, outer epithelium; *y*, circular muscular fibres; *z*, layer of connective tissue; *a*, inner epithelium; *b*, ovisac; *c*, germinal vesicle; *d*, germinal spot; *e*, vitellus; *f*, vitelline membrane.

PLATE XXXVIII.

Benthodytes abyssicola, n. sp.

Fig. 1. A small portion of the dorsal perisoma, seen from the outside, showing the openings of the madreporic canal and of the reproductive organs. *a*, pores of the madreporic canal; *b*, genital pore.

„ 2. The same openings of another individual. *a*, the pore of the madreporic canal; *b*, the genital pore.

Fig. 3. Transverse section of the dorsal perisoma to show the termination of the madreporic canal and the reproductive organs. *a*, pores of the madreporic canal; *b*, genital pore; *x*, perisoma; *A*, madreporic canal; *B*, efferent duct of the genital organs.

„ 4. Calcareous deposits from the madreporic canal.

Benthodytes typica, n. sp.

„ 5. Transverse section of the dorsal perisoma, showing the termination of the madreporic canal. *a*, that part of the madreporic canal which pierces the perisoma; *b*, funnel-shaped hollow in the dorsal integument; *c*, calcareous network surrounding the pore of the madreporic canal; *d*, spicula; *e*, epidermis; *f*, circular muscular fibres with epithelial lining; *g*, connective tissue.

Ilyodæmon maculatus, Théel.

„ 6. Transverse section of the dorsal perisoma showing the termination of the madreporic canal and the reproductive organs. *A*, madreporic canal; *B*, efferent duct of the reproductive organs; *a*, pores of the madreporic canal; *b*, genital process; *e*, epidermis; *f*, circular muscular fibres with epithelial lining; *g*, connective tissue.

„ 7. The pores of the madreporic canal and the genital process, seen from above. *s*, pores of the madreporic canal; *g*, genital process.

„ 8. Calcareous deposits from the madreporic canal.

Lætmogone wyville-thomsoni, Théel.

„ 9. Termination of the madreporic canal and the reproductive organs. *A*, madreporic canal; *B*, efferent duct of the reproductive organs; *a*, papillæ communicating with the madreporic canal; *b*, genital process; *c*, branch of the genital process.

Orphnurgus asper, Théel.

„ 10. View of the madreporic plate and the terminal part of the madreporic canal; seen from below.

Oneirophanta mutabilis, Théel.

„ 11. Side view of the madreporic canal. *a*, madreporic canal; *b*, efferent duct of the reproductive organs; *e*, mesentery; *m*, circular water-vessel; *x*, inner surface of the body-wall; *y*, madreporic tubercle.

„ 12. View of the madreporic tubercle, seen from below.

Benthodytes sordida, n. sp.

„ 13. Calcareous deposits from the madreporic canal.

PLATE XXXIX.

Psychropotes longicauda, var. *monstrosa*, n.

Fig. 1. The anterior portion of the body with the ventral perisoma, the alimentary canal, &c., removed to show that system of water-vascular vessels which penetrates or rather constitutes the brim round the body; twice the natural size. *a*, the brim which is rather broad especially round the anterior extremity of the body; *b*, terminal part of the madreporic canal; *c*, the foremost portion of the reproductive organs; *d*, ventral lateral ambulacra; *e*, dorsal ambulacra; *f*, the two dorsal main canals which connect the dorsal ambulacra and tentacles with the water-vascular ring; *g*, passage to the tentacles; *h*, a part of the brim deprived of the outer layer of the integument to show more distinctly the close-lying canals which enter the processes round the edge of the brim; *x*, processes or pedicels.

Elpidia verrucosa, Théel.

„ 2. Upper view of some pyramidal papillæ of the dorsal integument with their deposits, *in situ*.

Achlyonice paradoxa, Théel.

„ 3. A piece of the integument showing holes and cavities.

Lætmogone wyville-thomsoni, Théel.

„ 4. Inner view of the terminal part of a tentacle, the stem having been cut off; *a*, the rest of the stem; *b*, holes from canals lying within the thick sole-like end of the tentacle.

Lætmogone spongiosa, Théel.

„ 5. Traces of wheel in the integument.

„ 6. Traces of star-like deposit in the integument.

Achlyonice paradoxa, Théel.

„ 7. Traces of three-armed deposit in the integument.

PLATE XL.

Oneirophanta mutabilis, Théel.

Fig. 1. Injected pseudhæmal vessels from the ventral walls of the intestine. *a*, the large ventral stem; *b*, branches given off to the walls of the intestine; *c*, plexus of fine vessels within the walls of the intestine.

„ 2. Ventral view of the digestive tract, showing the pseudhæmal vessels; almost natural size. *a*, water-vascular ring; *b*, Polian vesicle; *c*, circular pseudhæmal vessel; *d*, ventral pseudhæmal stem; *e*, the long commissural vessel; *f*, the short commissural vessel; *x*, anal termination of the digestive tract.

Fig. 3. Posterior portion of the digestive tract opened. *a*, cloacal dilatation; *b*, anal portion of the digestive tract which is capable of being retracted within the body as well as extended beyond it; *c*, space enclosed by the double walls of the anal portion of the digestive tract; *d*, that part of the perisoma which surrounds the anus; *x*, muscular threads.

Benthodytes sanguinolenta, n. sp.

„ 4. A portion of the intestine; twice the natural size. *a*, intestine; *b*, diverticulum.

„ 5. Ventral view of the anterior part of the alimentary canal. *a*, water-vascular ring; *b*, ventral pseudhæmal vessel; *c*, oral portion of the digestive tract, visible through the mesentery which surrounds it; *d*, intestine; *e* dilatation of the intestine; *m*, mesentery; *o*, the main canals which proceed from the water-vascular ring; *p*, Polian vesicle.

Benthodytes sanguinolenta, var. *marginata*, n.

„ 6. Transverse section of the body; twice the natural size. *A*, dorsal surface; *B*, ventral surface; *D*, peritoneal cavity; *a*, processes of the dorsal ambulacra; *b*, pedicels of the odd ambulacrum; *c*, pedicels of the ventral lateral ambulacra; *m*, ventral ambulacra; *n*, dorsal ambulacra.

Euphronides depressa, n. sp.

„ 7. View of a part of the inner side of the odd interambulacrum; twice the natural size. *a*, dorsal ambulacra; *b*, ambulacral cavities communicating with the two canals which penetrate the azygous appendage; *x*, the connection of the cavities with the dorsal ambulacra.

Benthodytes sanguinolenta, var. *marginata*, n.

„ 8. Diagrammatic outlines of the lateral pedicels; twice the natural size. *a*, one of the lateral ambulacra; *b*, cylindrical cavities which enter the pedicels; *c*, pedicels; *d*, communication between the ambulacrum and the pedal cavities.

PLATE XLI.

Oneirophanta mutabilis, Théel.

Fig. 1. Upper view of a piece of the dorsal perisoma deprived of the outer layer of connective tissue which contains the calcareous deposits. *a*, longitudinal muscular band; *b*, transverse muscular layer; *c*, large branched ambulacral cavities, communicating with a dorsal process; *d*, base of a dorsal process directed outwards, the rest being cut off; *e*, small ambulacral cavity which does not communicate with any process; *l*, nerve branches; *m*, larger nerve passing to the process; *n*, ambulacral nerve stem. The radial ambulacral vessel does not appear.

Fig. 2. View of the ambulacral cavities which belong to one of the ventral lateral ambulacra, seen from the inner side of the body-wall; most of the connective tissue is removed. *a*, ventral lateral ambulacral vessel; *b*, longitudinal muscular band; *c*, transversal muscular layer; *d*, branch of the ambulacral vessel passing to a pedicel; *e*, openings into the pedicels, visible through the thin layer of circular muscular fibres as darker spaces; *f*, branched ambulacral cavities belonging to the pedicels and lying within the ventral perisoma; *g*, parts of the same ambulacral cavities crossing the radial ambulacral vessel and extending beyond it, thus lying within the lateral interambulacra; *h*, ambulacral cavity belonging to one of the processes of the ventral lateral ambulacrum; *k*, opening into this process, visible through the thin circular muscular layer as a darker space.

Orphnurgus asper, Théel.

„ 3. View of a portion of one of the ventral lateral ambulacra, seen from the peritoneal cavity; *a*, branched ambulacral cavity belonging to a pedicel and enclosed within the ventral perisoma; *b*, branched ambulacral vesicle or "ampulla" communicating with one of the processes of the ventral lateral ambulacrum and depending freely into the peritoneal cavity; *c*, branched ampulla-like prolongation of the ambulacral cavity just mentioned; *d*, longitudinal muscular band and radial ambulacral vessel.

Oneirophanta mutabilis, Théel.

„ 4. Transverse section of one of the ventral lateral ambulacra and of the adjacent body-wall. *a*, radial ambulacral vessel; *b*, ambulacral cavity of a process; *c*, ambulacral cavity of a pedicel from the outer row; *d*, ambulacral cavity of a pedicel from the inner row; *e*, cavities communicating with adjacent processes or pedicels; *f*, inner pedicel; *g*, outer pedicel; *h*, process.

Achlyonice paradoxa, Théel.

„ 5. View of the anterior part of the odd interambulacrum, seen from the inner side. *a*, ambulacral cavities of the dorsal processes; *b*, longitudinal muscular bands and ambulacral vessels; *x*, the anterior part of the odd interambulacrum.

PLATE XLII.

Lætmogone wyville-thomsoni, Théel.

Fig. 1. Transverse section of one of the ambulacra; the outer layer of the integument is removed. *a*, outer pigmentary layer of the ambulacral nerve; *b*, inner pigmentary layer of the ambulacral nerve; *c*, thick yellowish almost structureless membrane separating the nerve from the ambulacral vessel; *d*, neural canal; *e*, ambulacral vessel; *f*, longitudinal muscular band; *g*, transversal muscular layer; *h*, layer of connective tissue of the integument; *k*, small wheels; *l*, spicula; *m*, yellowish pigment; *n*, nerve; *p*, violet pigment; *s*, larger cells.

Lætmogone violacea, Théel.

„ 2. View of the ambulacral cavities of the pedicels, seen from the inner side of the body-wall; most of the integument is removed. *a*, radial ambulacral vessel; *b*, ambulacral cavities lying closely crowded side by side within the ventral perisoma; *c*, pointing out the position of the pedicels; *n*, ambulacral nerve; *m*, longitudinal muscular band.

By mistake this figure is referred to *Lætmogone wyville-thomsoni* on the plate, and the lithographer has wrongly drawn the dotted line at *m* beyond the inner limit of the muscular band.

Ilyodæmon maculatus, Théel.

Fig. 3. Transverse section of the dorsal perisoma showing the dorsal ambulacra and the processes which communicate with them; twice the natural size. *a*, ambulacral vesicles or ampullæ; *b*, dorsal processes; *c*, cavities within the perisoma.

„ 4. View of the ambulacral cavities of the pedicels, seen from the outer side of the body; most of the integument is removed. *a*, radial ambulacral vessel; *b*, branched ambulacral cavities with their bases placed side by side; *f*, bases of the pedicels, the rest of them being cut off; *m*, longitudinal muscular bands.

Kolga nana, Théel.

„ 5. View of a portion of the left ventral interambulacrum, seen from the inner side. *a*, odd ambulacrum; *b*, the left ventral lateral ambulacrum; *c*, ambulacral cavities of the pedicels; *d*, auditory vesicles.

Benthodytes sanguinolenta, n. sp.

„ 6. Diagrammatic side view of a minute dorsal process, highly magnified. *a*, ambulacrum; *b*, the integument; *c*, process.

Lætmogone wyville-thomsoni, Théel.

Fig. 7. View of an ambulacral cavity of a dorsal process, seen from above; most of the integument is removed. *a*, ambulacrum; *b*, ambulacral cavity; *d*, opening of the process into the ambulacral cavity. The process itself is cut off, only its basal portion being left.

Kolga nana, Théel.

„ 8. Half-schematic transverse section of the odd ambulacrum; *a*, connective tissue of the integument; *c*, longitudinal muscular band; *d*, ambulacral vessel; *n*, radial nerve stem.

Oneirophanta mutabilis, Théel.

„ 9. Half-schematic representation of a transverse section of a dorsal ambulacrum. *a*, inner layer of connective tissue of the integument; *b*, transverse muscular layer; *c*, longitudinal muscular layer; *d*, ambulacral vessel; *e*, thick hyaline membrane separating the ambulacral vessel from the radial nerve cord; *f*, cavities or branches which probably belong to the ambulacral cavities of the dorsal processes; *g*, epithelium lining the perivisceral cavity; *n*, radial nerve cord.

PLATE XLIII.

Oneirophanta mutabilis, Théel.

Fig. 1. Longitudinal section of the head-part. *a*, main canals which combine the water-vascular ring with the tentacles and the radial ambulacral vessels; *b*, water-vascular ring; *c*, circular pseudhæmal vessels; *d*, ventral pseudhæmal vessel; *k*, calcareous ring; *m*, elastic bands and threads; *n*, nerve ring; *o*, anterior portion of the oral cavity; *p*, posterior portion of the oral cavity; *r*, œsophagus; *s*, intestine; *t*, tentacular cavities; *v*, circular fold or valve; *x*, Polian vesicle.

Deima fastosum, Théel.

„ 2. View of the perisoma round the anterior closed aperture of the body; twice the natural size. *a*, minute papillæ placed in a ring round the disk-like portion of the perisoma; *b*, aperture into the foremost portion of the alimentary canal.

„ 3. Side view of the foremost portion of the alimentary canal, with the left side removed to show the position of the tentacles. *a*, the oral cavity; *b*, tentacles retracted; *c*, anterior aperture of the alimentary canal; *d*, perisoma round the aperture; *e*, layer of circular muscles; *f*, fold. Twice the natural size.

Lætmogone wyville-thomsoni, Théel.

Fig. 4. Side view of the anterior portion of the body, with the left side removed to show the position of the inner organs. *a*, madreporic canal; *b*, papillæ in connection with the madreporic canal; *c*, genital process; *d*, efferent duct of the reproductive organs; *e*, pseudhæmal vessels; *f*, calcareous ring; *g*, reproductive organs; *h*, Polian vesicle; *i*, water-vascular ring; *k*, main canals combining the water-vascular ring with the tentacles and the radial ambulacral vessels; *m*, radial ambulacral vessels; *t*, tentacles; *x*, the foremost portion of the perisoma of the left side turned forwards.

Deima fastosum, Théel.

„ 5. A part of the system of canals which surround the foremost portion of the alimentary canal and are in connection with the small papillæ which are presented in figure 2 of this plate. *a*, papillæ; *b*, part of the disk-like perisoma which surrounds the anterior aperture of the body; *c*, the blind ends of the canals cut off; *d*, canals; *e*, nerves.

Oneirophanta mutabilis, Théel.

„ 6. Side view of the anterior portion of the body with the left side removed to show the inner organs. *a*, madreporic canal; *b*, efferent duct of the reproductive organs; *c*, pseudhæmal vessel passing to the reproductive organs; *d*, male reproductive organs; *e*, mesentery; *f*, dorsal pseudhæmal vessel; *g*, intestine; *h*, Polian vesicle; *i*, ventral pseudhæmal vessel; *k*, elastic bands and threads; *l*, circular pseudhæmal vessel; *m*, water-vascular ring; *n*, radial ambulacral vessels; *o*, minute apertures visible through the thin walls of the water-vascular system, by which apertures the five main canals communicate with the tentacles and the radial ambulacral vessels; *p*, opening formed by the medio-dorsal mesentery; *r*, main canals. Natural size.

Deima validum, Théel.

„ 7. View of the termination of the odd ventral main canal into the tentacles and odd radial ambulacral vessel. *a*, a portion of the odd main canal; *b*, calcareous ring; *c*, branches of the main canal passing to the tentacles; *m*, tentacular cavities; *n*, nerve ring; *o*, tentacular nerves; *k*, the same minute canals which are represented in the figures 2 and 5 of this plate; *x*, odd radial ambulacral vessel; *y*, branch of the main canal which passes into the odd radial ambulacral vessel; *z*, ventral body-wall. The tentacles as well as the ends of the fine canals are removed.

PLATE XLIV.

Psycheotrephes exigua, n. sp.

Fig. 1. View of the outwardly directed side of a tentacle.

Scotoplanes mollis, Théel.

„ 2. Processes of one of the dorsal ambulacra.

Orphnurgus asper, Théel.

„ 3. Terminal part of a tentacle.

Scotoplanes murrayi, Théel.

„ 4. Terminal part of a tentacle.

Peniagone wyvillii, n. sp.

„ 5. Terminal part of a tentacle.

Elpidia purpurea, n. sp.

„ 6. Terminal part of a tentacle.

Peniagone wyvillii, n. sp.

„ 7. Branch of the terminal part of a tentacle.

Benthodytes typica, n. sp.

„ 8. A dorsal process retracted. *a*, canal which pierces the perisoma and combines the dorsal process with one of the dorsal ambulacra.

Scotoanassa diaphana, n. sp.

„ 9. Terminal part of a tentacle.

Peniagone vitrea, n. sp.

„ 10. Terminal part of a tentacle.

Ilyodæmon maculatus, Théel.

„ 11. Terminal part of a tentacle showing branched canals which communicate with the tentacular cavity and lie enclosed within the thick sole-like terminal part.

Scotoplanes globosa, Théel.

„ 12. Terminal part of a tentacle.

Deima validum, Théel.

„ 13. Longitudinal section of the end-portion of a slightly retracted pedicel. *a*, outer layer of the integument containing calcareous plates;

b, inner layer of the integument with scattered spicula; *c*, muscular layer.

Lætmogone wyville-thomsoni, Théel.

Fig. 14. Diagrammatic view of a transverse section of the thick terminal part of a tentacle. *a*, tentacular cavity; *b*, branched canals lying within the thick sole-like terminal part.

PLATE XLV.

Oneirophanta mutabilis, Théel.

Fig. 1. Plexus of pigmented nerves from the integument.
„ 2. Nerve-cell produced into three processes.
„ 3. Nerve-cell produced into several processes.
„ 4. Portion of a nerve-branch from a dorsal process.
„ 5. Nerve-ring. *a*, branches passing to the tentacles; *b*, radial nerve-stems; *c*, branches passing to the oral disk and the oral cavity.
„ 6. Cells from the connective tissue of the integument. *a*, cell produced into five processes; *b*, cell with three processes; *c*, cell with two processes.

PLATE XLVI.

Ilyodæmon maculatus, Théel.

Fig. 1. View of the reproductive organs with the branches of the one side removed. *a*, efferent duct.

Lætmogone wyville-thomsoni, Théel.

„ 2. A portion of the female reproductive organs.
„ 3. A portion of the male reproductive organs.

Euphronides depressa, n. sp.

„ 4. View of the female reproductive organs taken from the animal dredged at Station V. Twice the natural size.

Deima validum, Théel.

„ 5. View of the reproductive organs; the tubes of the one side removed. Twice the natural size. *a*, efferent duct.

Oneirophanta mutabilis, Théel.

„ 6. View of the male reproductive organs. Twice the natural size. *a*, efferent duct.

Fig. 7. View of the female reproductive organs. Twice the natural size. *a*, efferent duct.

Deima fastosum, Theel.

,, 8. View of the reproductive organs. One and a half times the natural size. *a*, efferent duct.

Benthodytes abyssicola, Theel.

,, 9. View of the male reproductive organs. Twice the natural size. *a*, efferent duct.

,, 10. View of the female reproductive organs. Twice the natural size. *a*, efferent duct.

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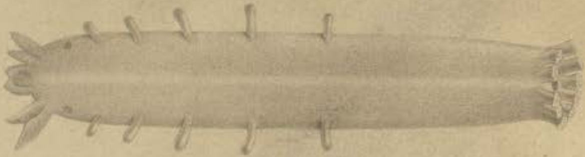

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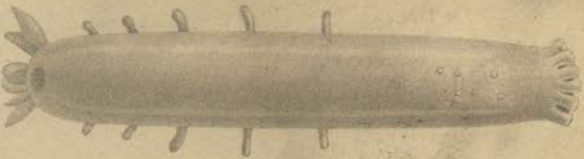

Fig 3.

Fig 1.

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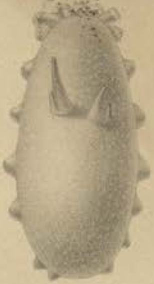
1-2, PARELPIDIA CYLINDRICA, n. sp. 3-4, PARELPIDIA ELONGATA, Théel.

Fig. 1.



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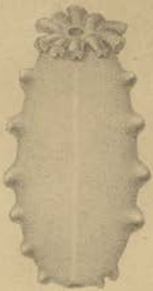

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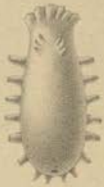

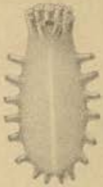

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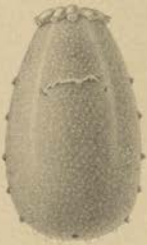

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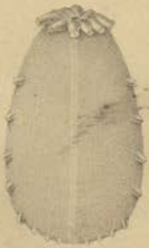

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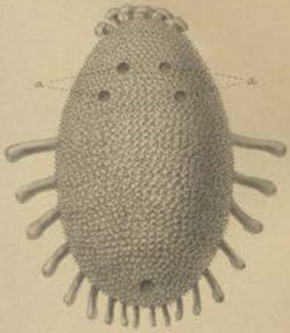
1-2, SCOTOPLANES MOLLIS, Théel. 3-4, KOLGA NANA, Théel. 5-6, SCOTOPLANES PAPILLOSA, Théel.

Fig. 1.



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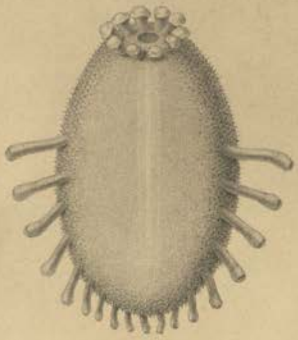

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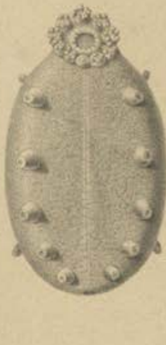

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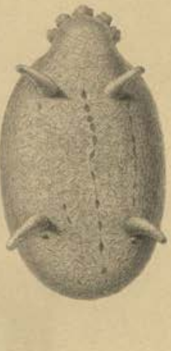

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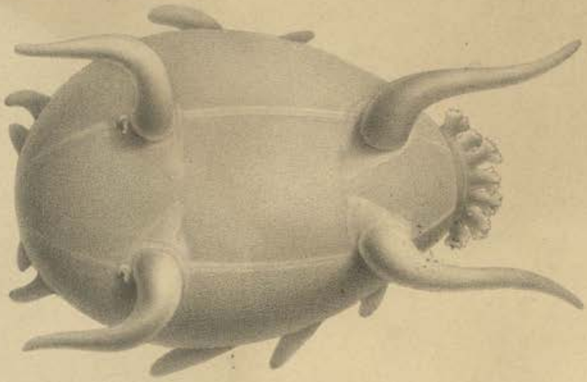
1-2, ELPIDIA VERRUCOSA, Théel. 3-4, SCOTOPLANES MURRAYI, Théel.



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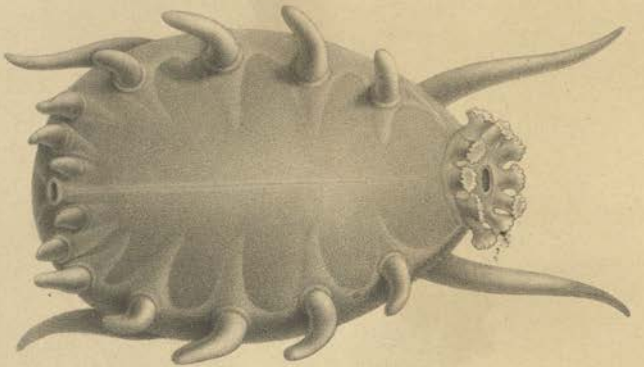

Fig. 2.

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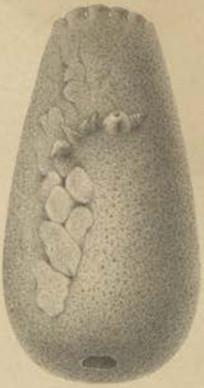
SCOTOPLANES GLOBOSA, Théel.

Fig. 1.



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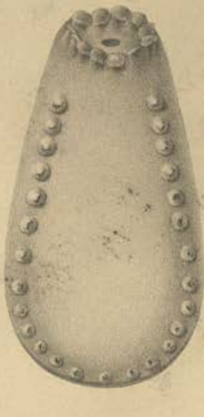

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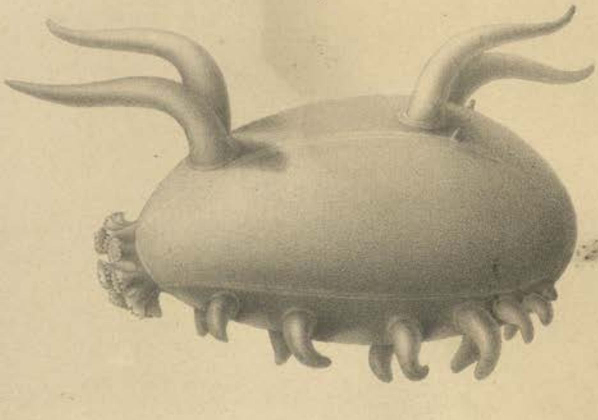

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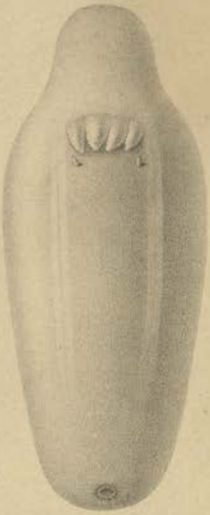
1-2. ACHLYONICE PARADOXA, Théel. 3. SCOTOPLANES GLOBOSA, Théel.

Fig. 2.



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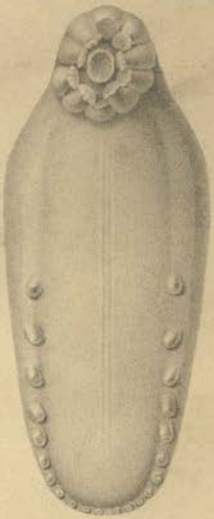

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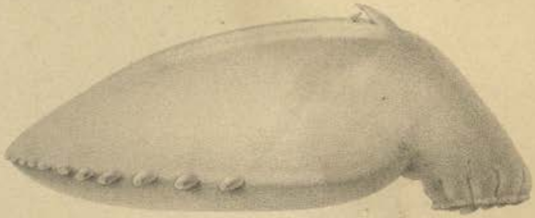

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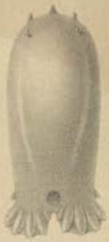
SCOTOPLANES ROBUSTA, n. sp.

Fig. 1.



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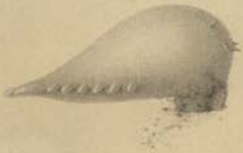

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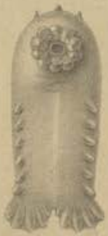

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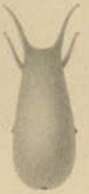

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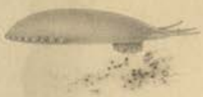

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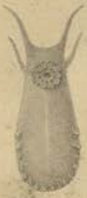

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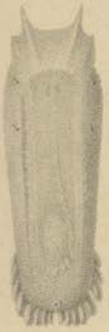

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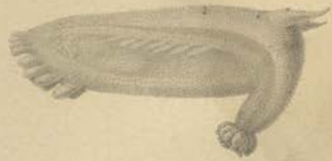

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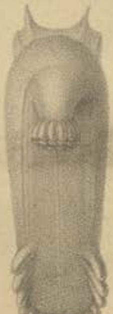

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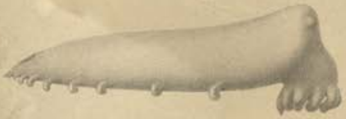
1-3, SCOTOPLANES INSIGNIS, n. sp. 4-6, ELPIDIA PURPUREA, n. sp.
7-9, PENIAGONE VITREA, n. sp.

Fig. 1.



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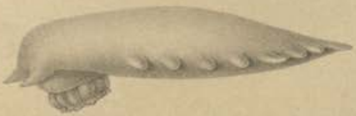

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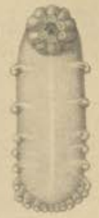

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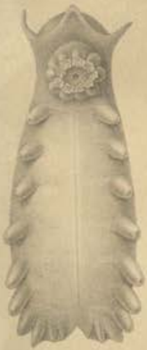

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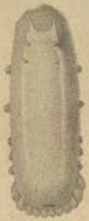

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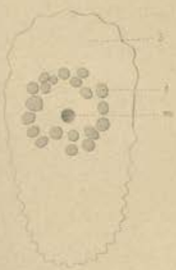

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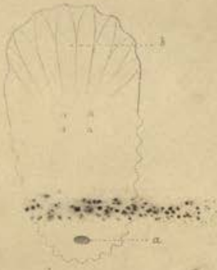

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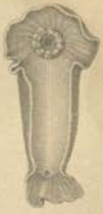

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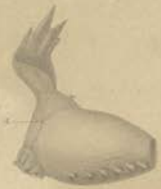
I, ELPIDIA INCERTA, n. sp. 2-3, ELPIDIA WILLEMOESI, n. sp. 4-5, PENIAGONE AFFINIS, n. sp.
6-7, ENYPNIASTES EXIMIA, n. sp. 8, PSYCHOTREPHOS EXIGUA, n. sp.

Fig. 1.



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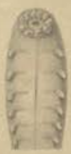

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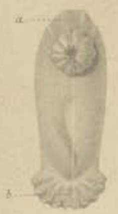

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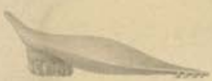

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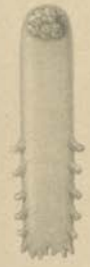
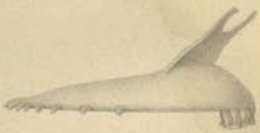


Fig. 7.



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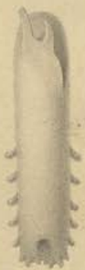
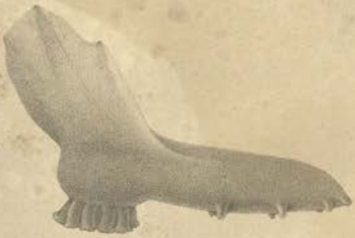


Lindberg del.

F. Huth, Lith.r Edin.r

1-2, PENIAGONE NARESI, n.sp. 3-5, SCOTOANASSA DIAPHANA, n.sp.
6-8, PENIAGONE CHALLENGERI, n.sp.

Fig. 1.



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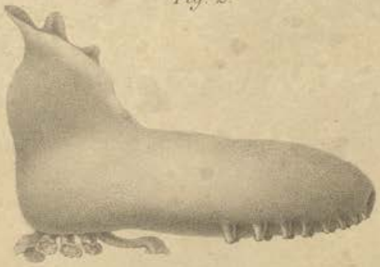

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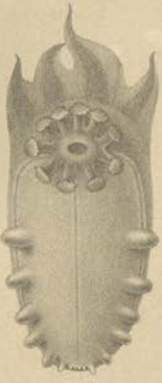

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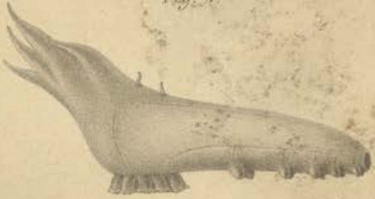

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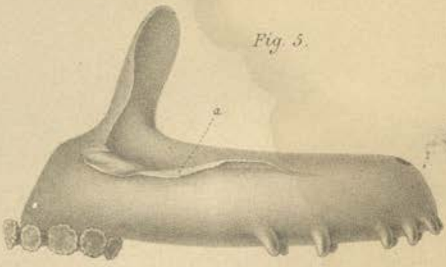
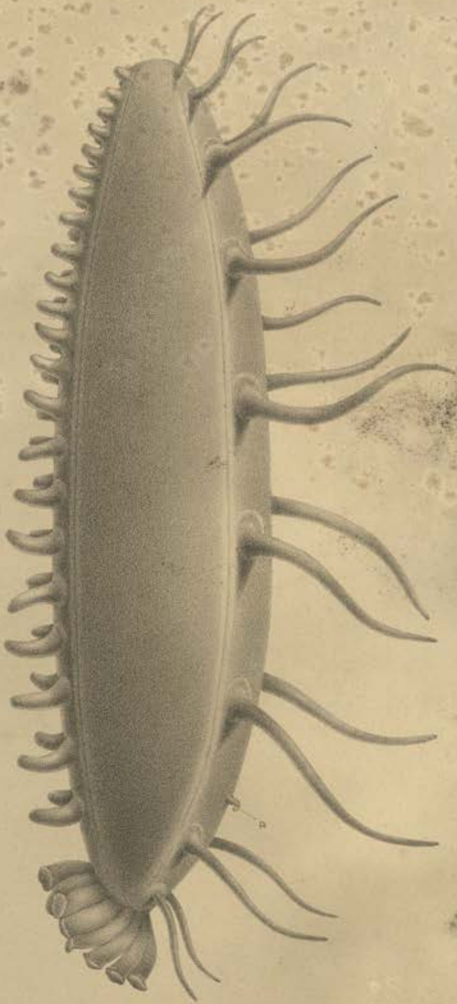


Lindberg del.

F. Huth, Lith.r Edin.r

1. PENIAGONE LUGUBRIS, n. sp. 2. PENIAGONE HORRIFER, n. sp.
3-4. PENIAGONE WYVILLII, n. sp. 5. PENIAGONE ATROX, n. sp.



Lindberg del.

F. Huth, Lith^r Edin^r

LÆTMOGONE WYVILLE-THOMSONI, Théel.

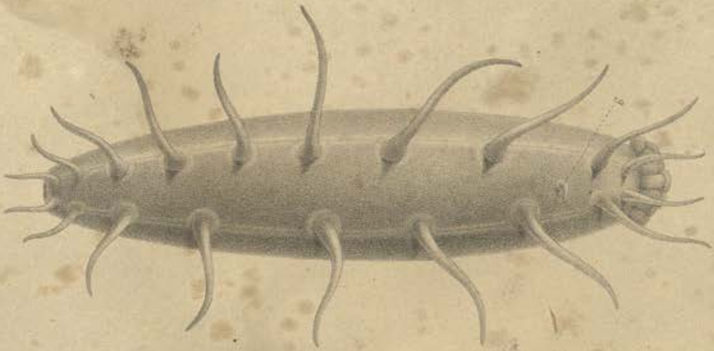


Fig 1.

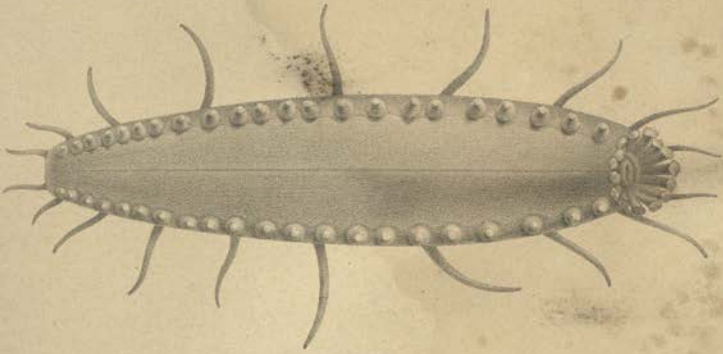


Fig 2.

Lindberg, del.

F. Huth, Lith^r Edin^r

LÆTMOGONE WYVILLE-THOMSONI, Théel.

Fig. 2.

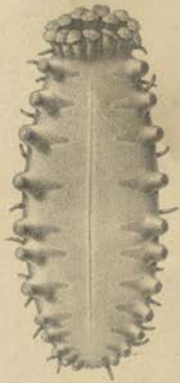


Fig. 3.

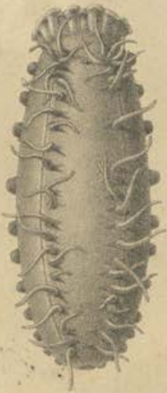
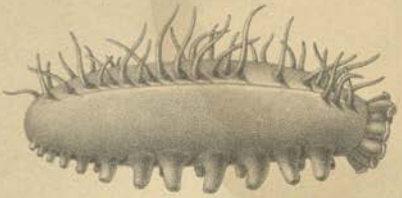


Fig. 1.



Lindberg del.

F. Huth, Lith.r Edin.r

LÆTMOGONE VIOLACEA, Théel.

Fig. 2.

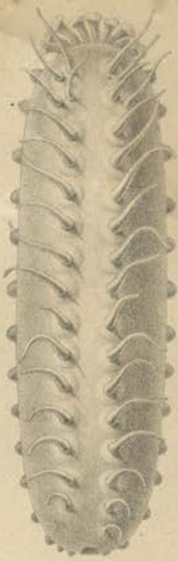


Fig. 3.

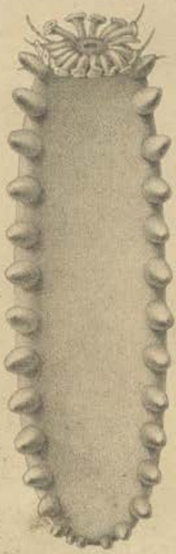
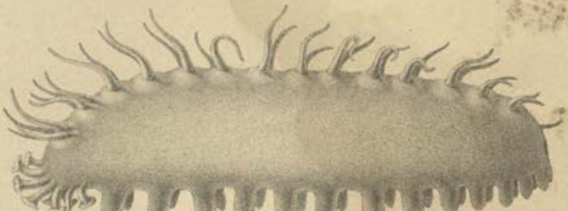


Fig. 1.



Lindberg, del.

F. Huth, Lith.r Edin.r

LÆTMOGONE SPONGIOSA, Théel.

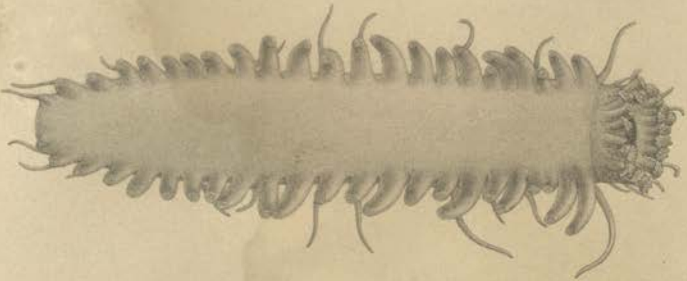


Fig. 1.

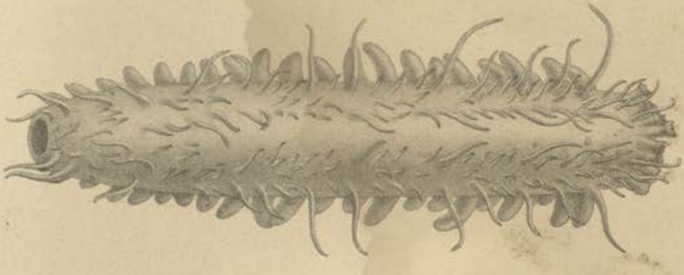


Fig. 2.

Lindberg del.

F. Huth, Lith^r Edin^r

ORPHNURGUS ASPER, Théel.

Fig. 2.

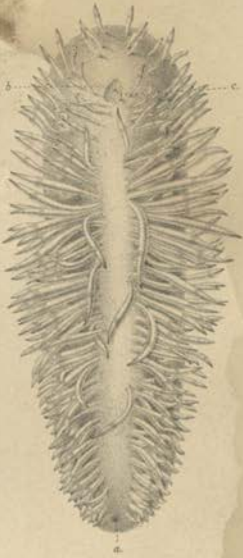


Fig. 3.

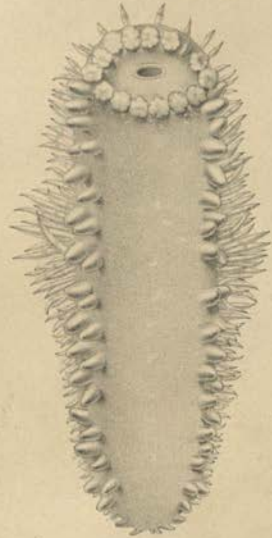
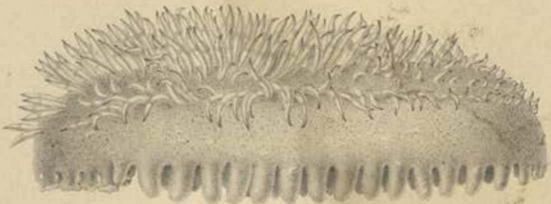


Fig. 1.



Lindberg, del.

F. Huth, Lith.r Edin.r

ILYODÆMON MACULATUS. Théel.

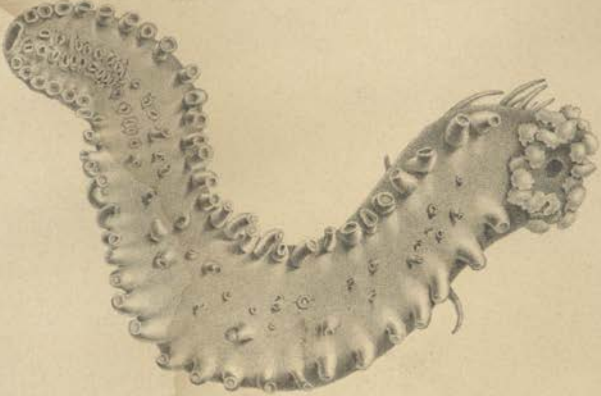


Fig. 1.

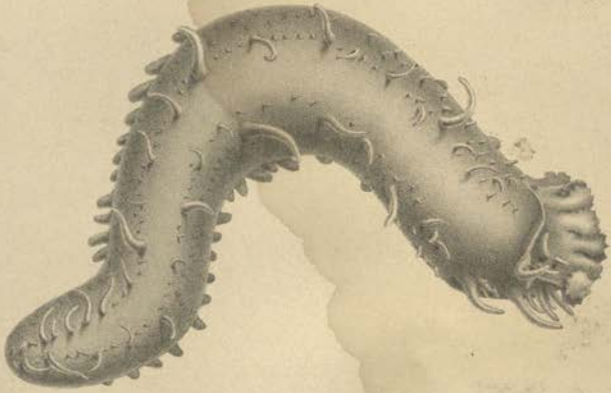
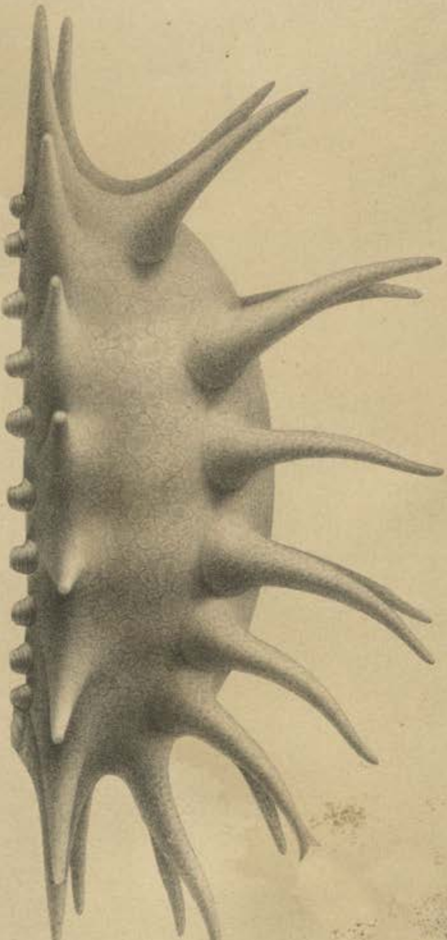


Fig. 2.

Lindberg del.

PANNYCHIA MOSELEYI, n. sp.

F. Huth, Lith.r Edin.r



Lindberg, del.

F. Huth, Lith^r Edin^r

DEIMA VALIDUM, THÉEL.

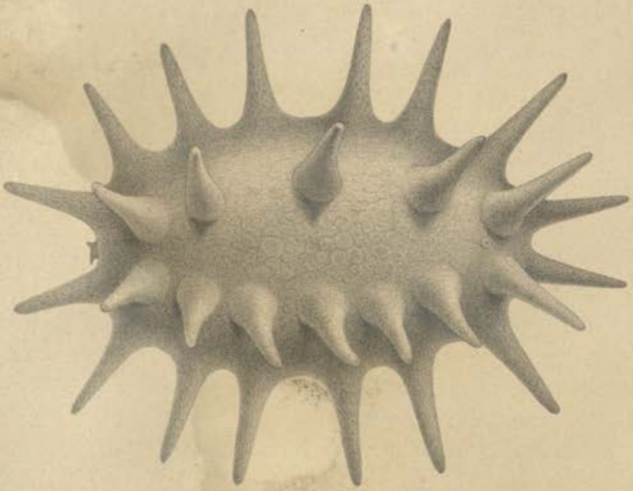


Fig. 1

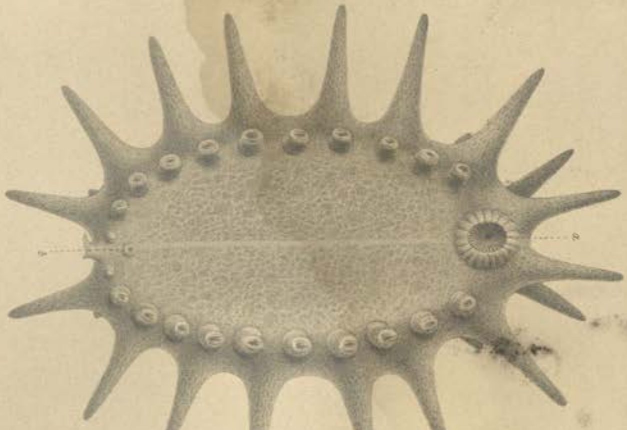


Fig. 2

Lindberg, del.

F. Huth, Lith.r Edin.r

DEIMA VALIDUM, Théel.

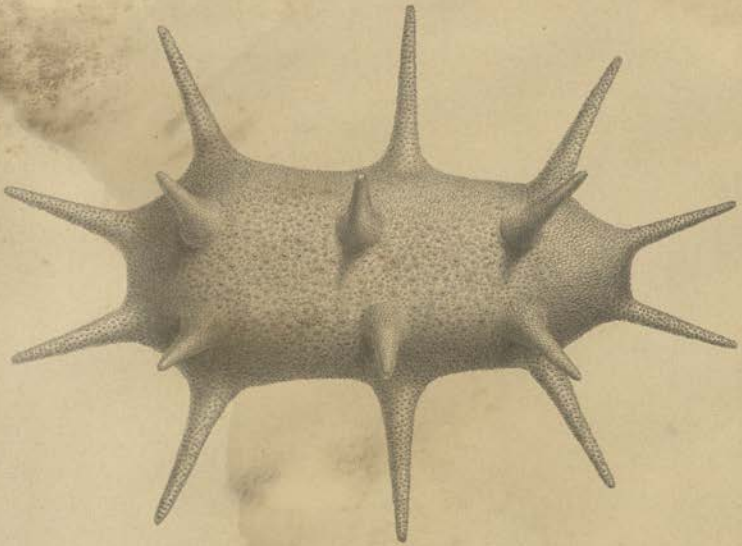


Fig. 1

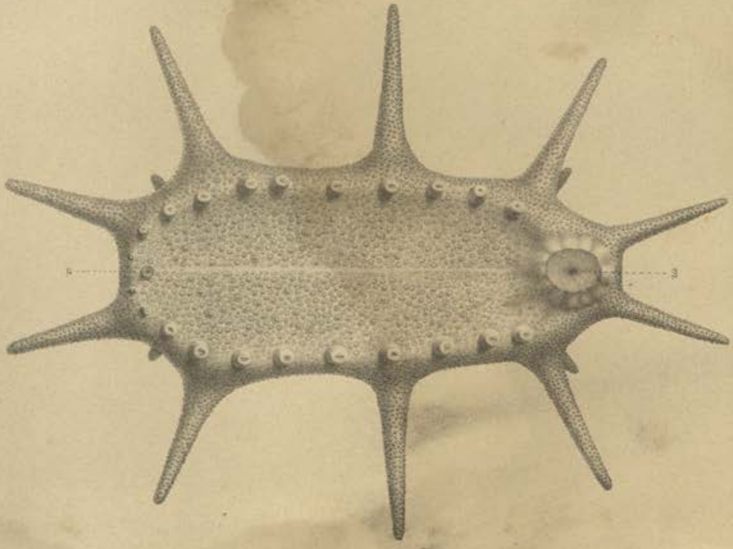


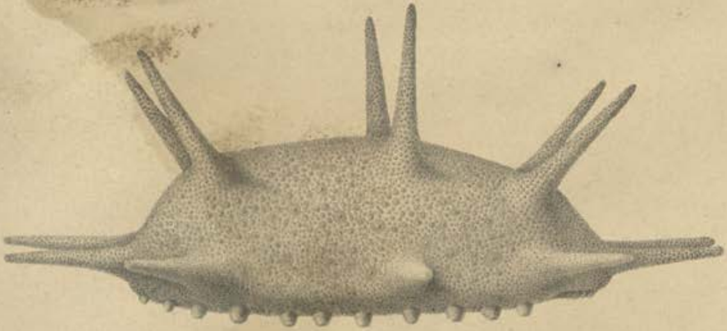
Fig. 2

Lindberg del.

F. Huth, Lith.r Edin.r

DEIMA FASTOSUM, Théel.

Fig. 1.



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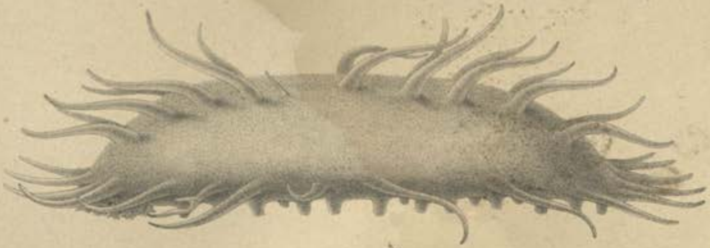
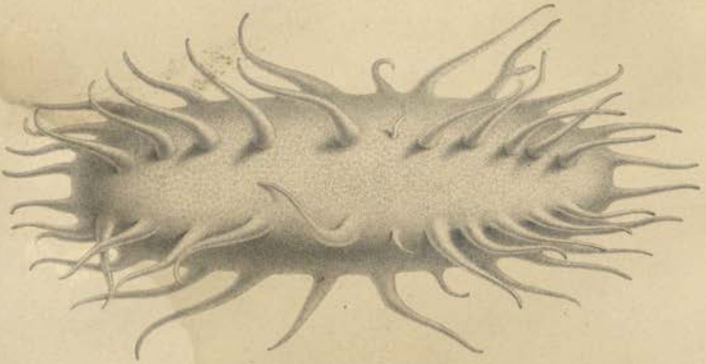


Lindberg, del.

F. Huth, Lith.r Edin.r

1. DEIMA FASTOSUM, Théel. 2. ONEIROPHANTA MUTABILIS, Théel.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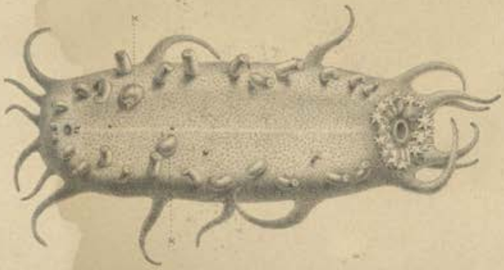
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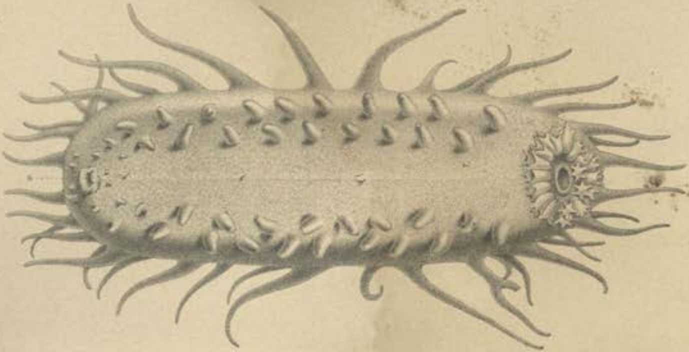
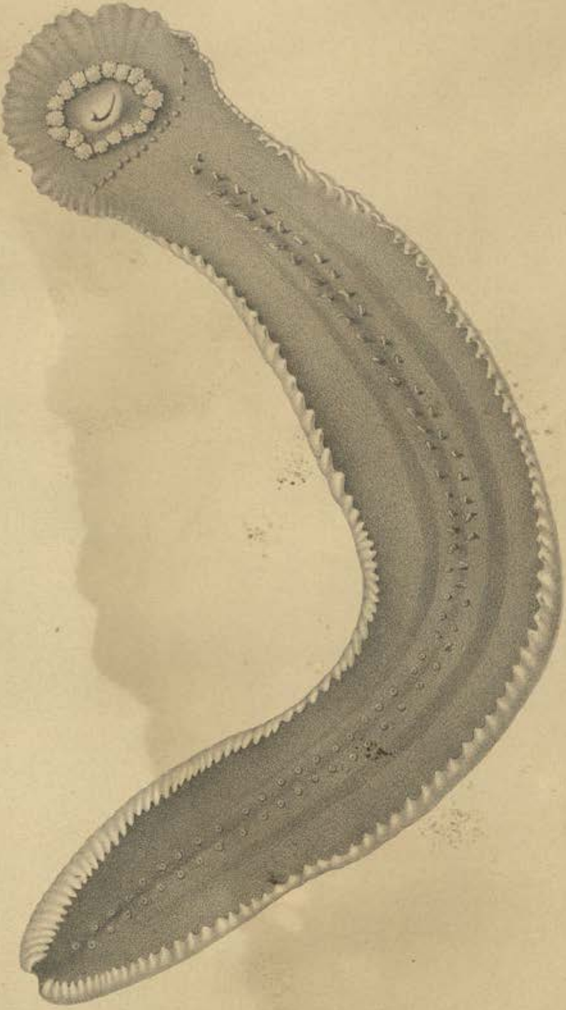


Fig. 2.

Lindberg del.
F. Huth, Lith.r Edin.r

ONEIROPHANTA MUTABILIS, Théel.

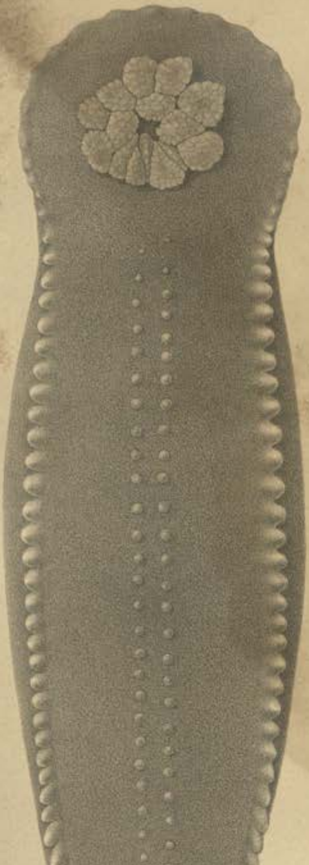


H. Théel del.

F. Huth. Lith^r Edin^r

BENTHODYTES SANGUINOLENTA, n. sp.

Fig. 1.



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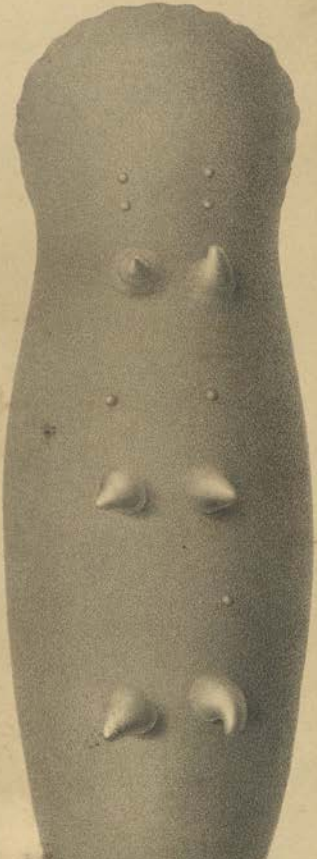


R. Kidston del.

F. Huth, Lith^r. Edin^r.

BENTHODYTES SORDIDA, n. sp.

Fig. 1

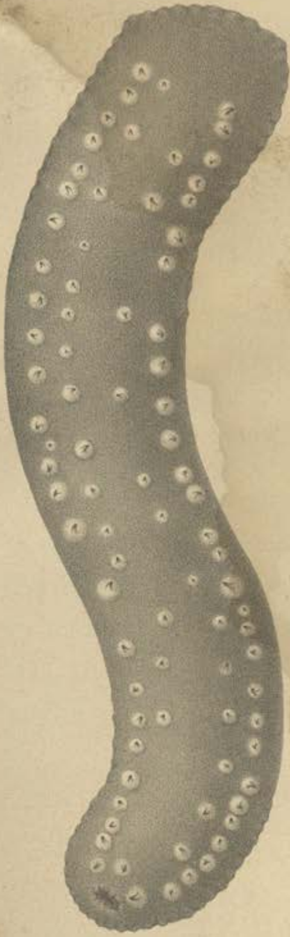
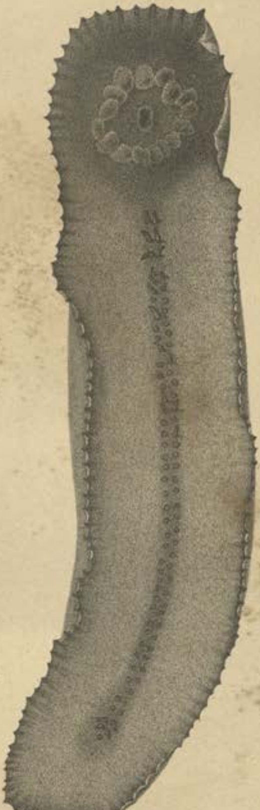


Fig. 2



R. Köster del.

F. Huth, Lith^{r} Edin^{r}

1. BENTHODYTES MAMILLIFERA, n. sp. 2. BENTHODYTES SANGUINOLENTA, var. MARGINATA, n.

Fig. 2.

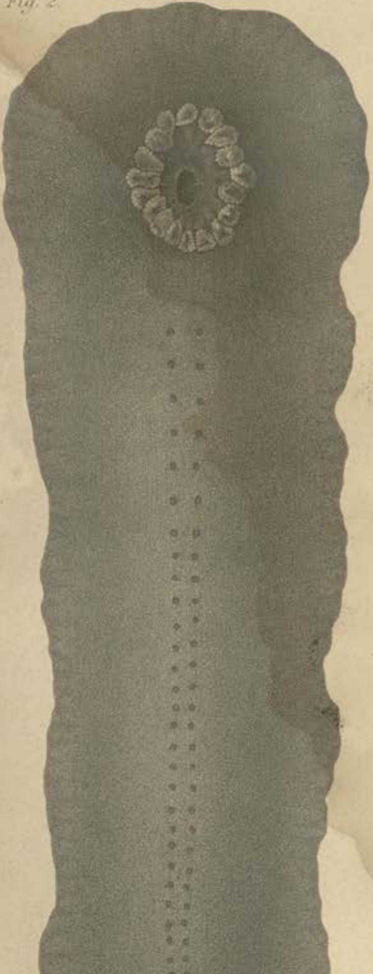
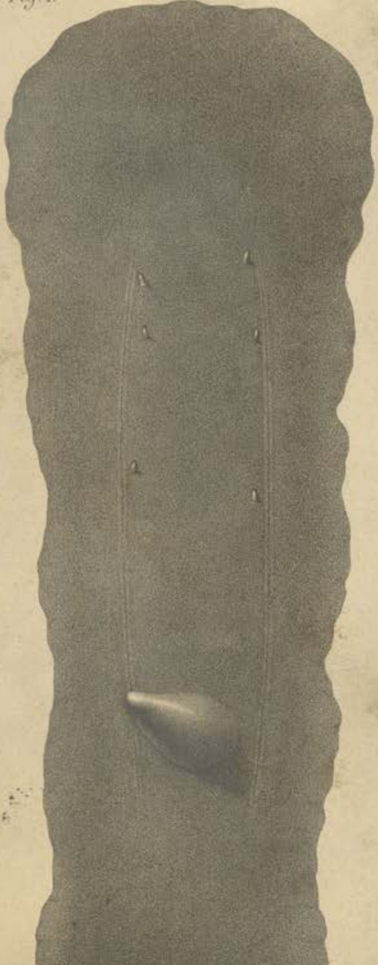


Fig. 1.



R. Kidston del.

T. Huth, Lith^{r} Edin^{r}

EUPHRONIDES DEPRESSA, n. sp.

Fig. 1.

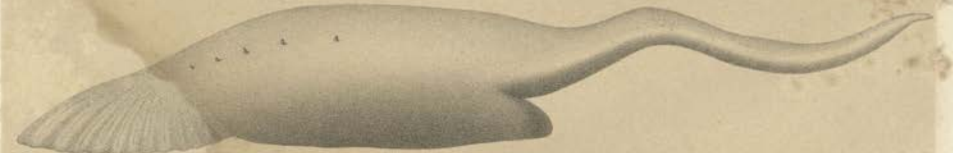


Fig. 2.

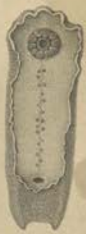
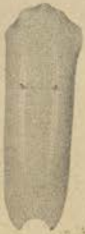


Fig. 3.

Fig. 4.



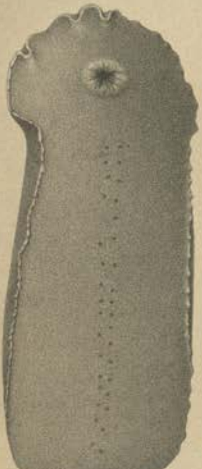
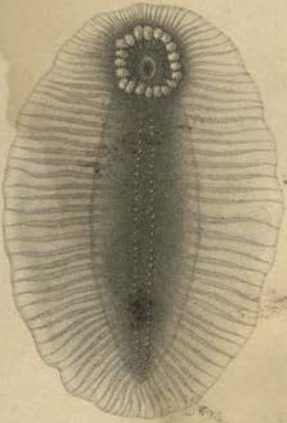


Fig. 5



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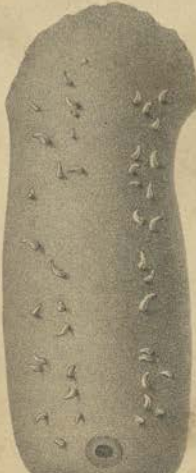


Fig. 6.

H. Théel del.

F. Huth, Lith.r Edin.r

1 PSYCHROPOTES LONGICAUDA, n. sp. 2-4 PSYCHROPOTES LOVÉNI, n. sp.
5-6 BENTHODYTES SELENKIANA, n. sp. 7 BENTHODYTES TYPICA, n. sp.

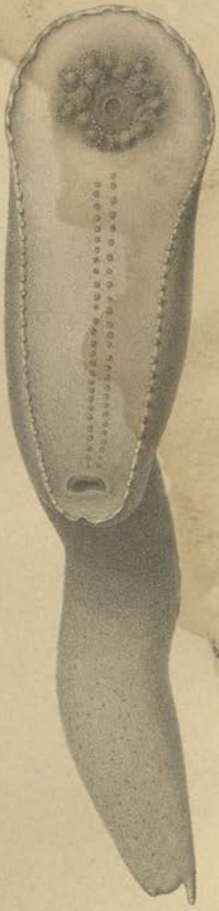


Fig. 1.

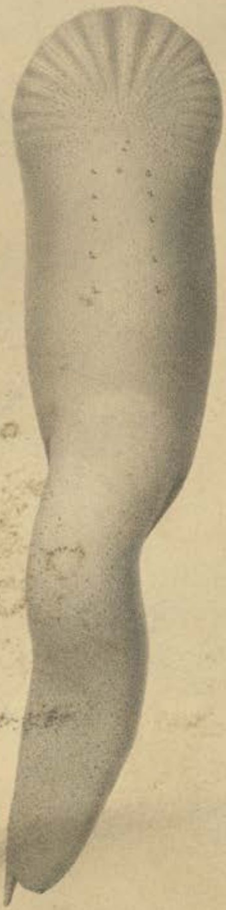


Fig. 2.

H. Théel del.

F. Huth, Lith.r Edin.r

PSYCHROPOTES LONGICAUDA, n. sp.

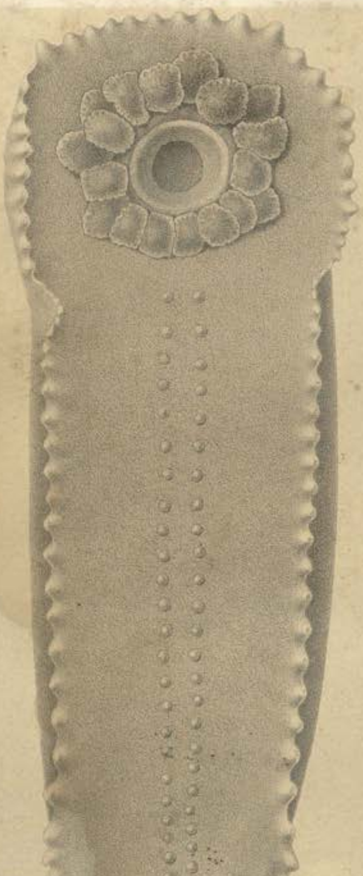
Fig. 2.

Fig. 1.

H. Théel del.

F. Huth, Lith.r Edin.r

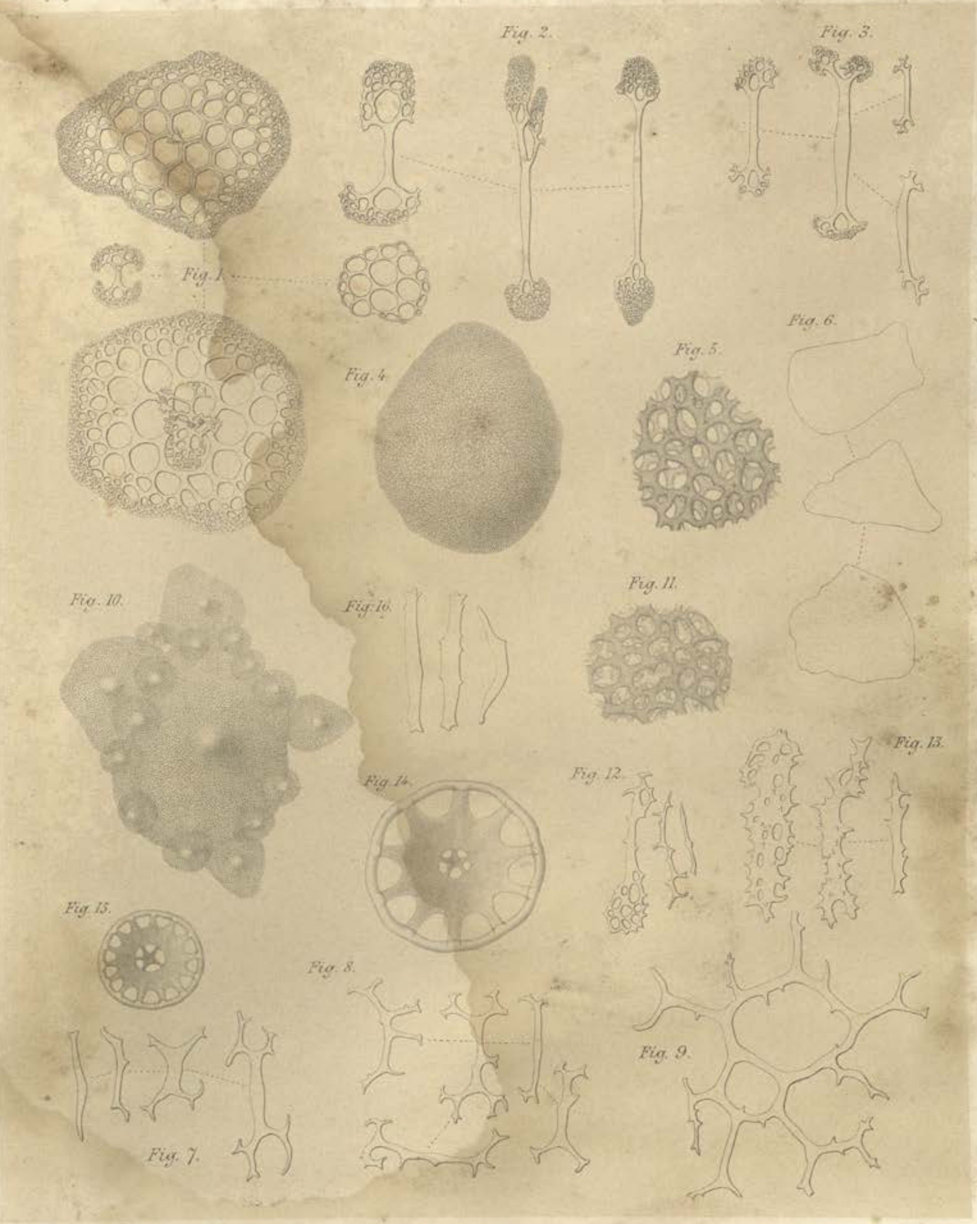
1. PSYCHROPOTES LONGICAUDA, var. FUSCO-PURPUREA, n. 2. PSYCHROPOTES LONGICAUDA, var. MONSTROSA, n.



H. Théel del.

F. Huth, Lith.r Edin.r

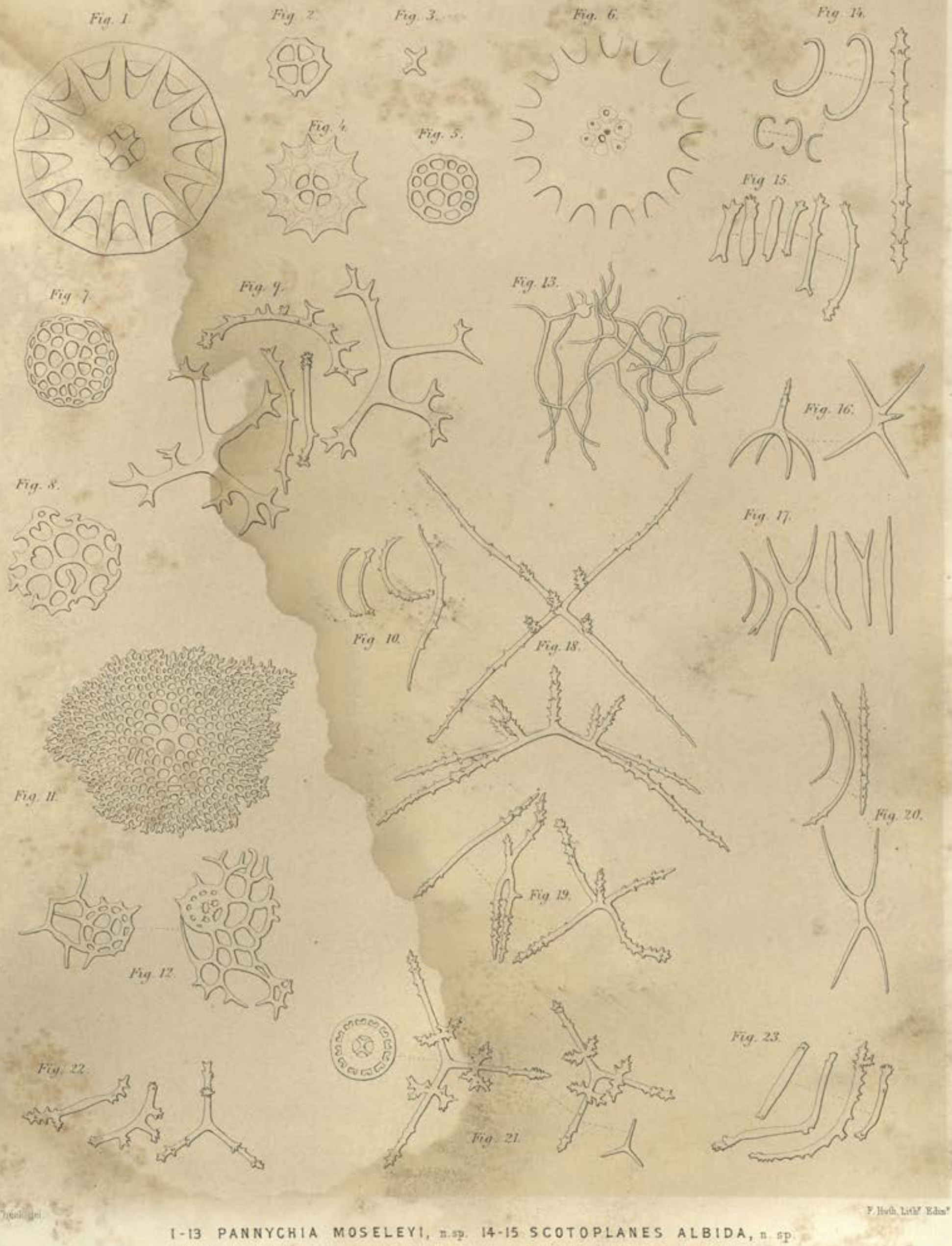
PSYCHROPOTES LONGICAUDA, var. MONSTROSA, n.



Lindberg del.

F. Huth, Lith.r Edin.r

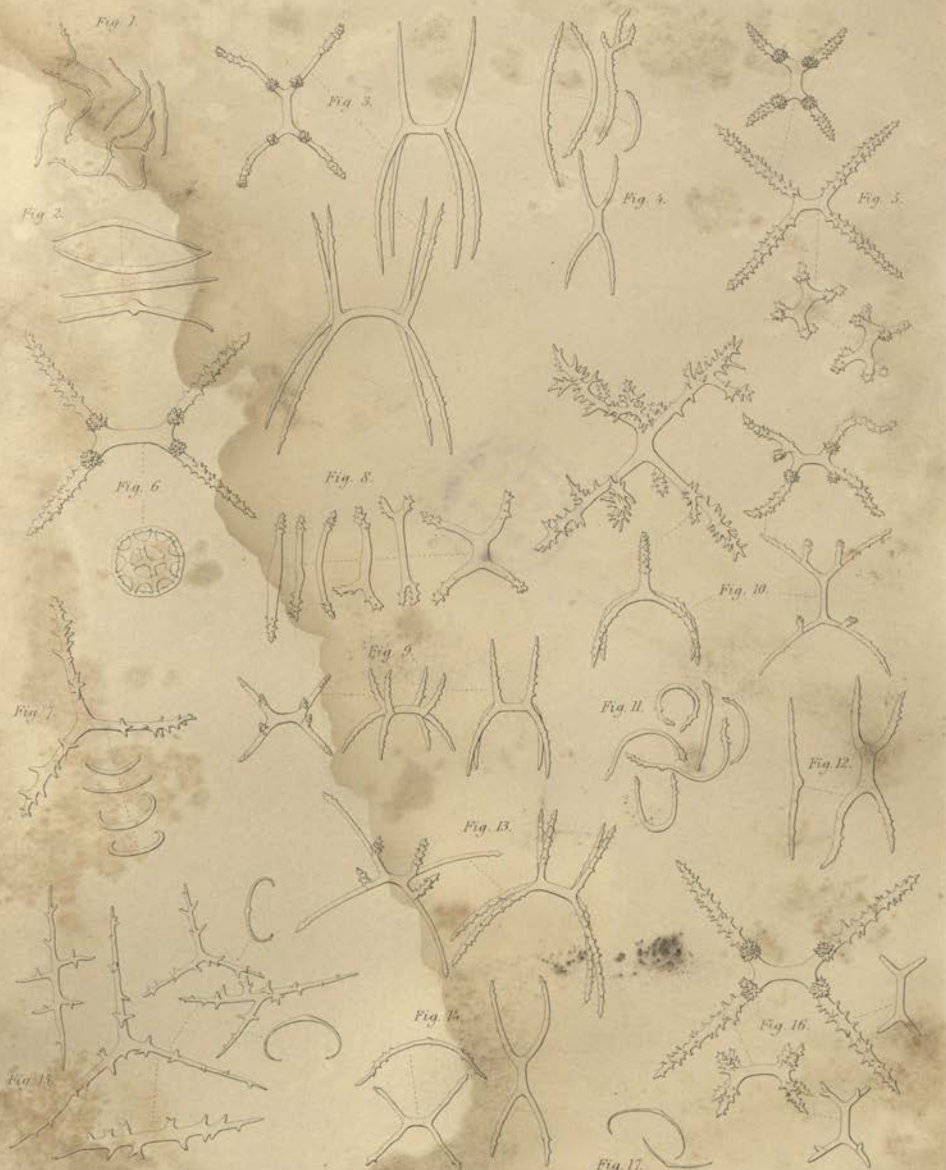
1-3 ONEIROPHANTA MUTABILIS, Théel. 4-9 DEIMA VALIDUM, Théel.
10-13 DEIMA FASTOSUM, Théel. 14-15 LÆTMOGONE WYVILLE-THOMSONI, Théel.



H. Thiesing del.

F. Huth, Lith.r Edin.r

1-13 PANNYCHIA MOSELEYI, n. sp. 14-15 SCOTOPLANES ALBIDA, n. sp.
16-17 PARELPIDIA ELONGATA, Théel. 18-20 ELPIDIA RIGIDA, n. sp.
21-23 ACHLYONICE LACTEA, n. sp.



H. Théel del.

F. Huth, Lith' Edin'

1-2 KOLGA NANA, Théel. 3-4 ELPIDIA INCERTA, n. sp. 5 PENIAGONE ATROX, n. sp. 6 ELPIDIA AMBIGUA, n. sp.
7 SCOTOPLANES INSIGNIS, n. sp. 8-9 PENIAGONE HORRIFER, n. sp. 10-12 ELPIDIA WILLEMOËSI, n. sp.
13-14 ELPIDIA PURPUREA, n. sp. 15 PENIAGONE NARESI, n. sp. 16 PENIAGONE CHALLENGERI, n. sp.
17 SCOTOPLANES MOLLIS, Théel.

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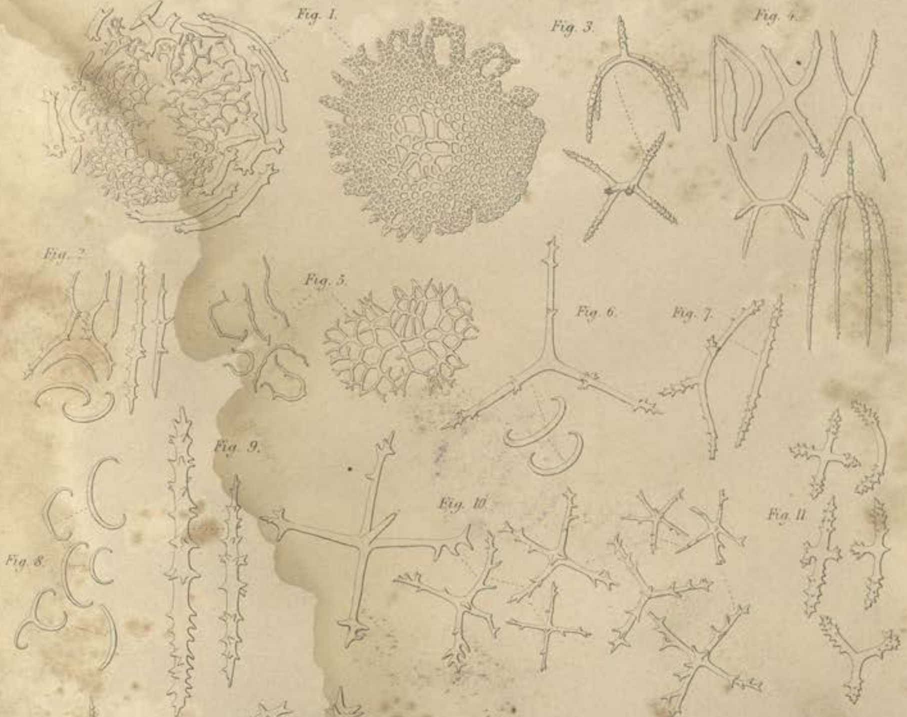
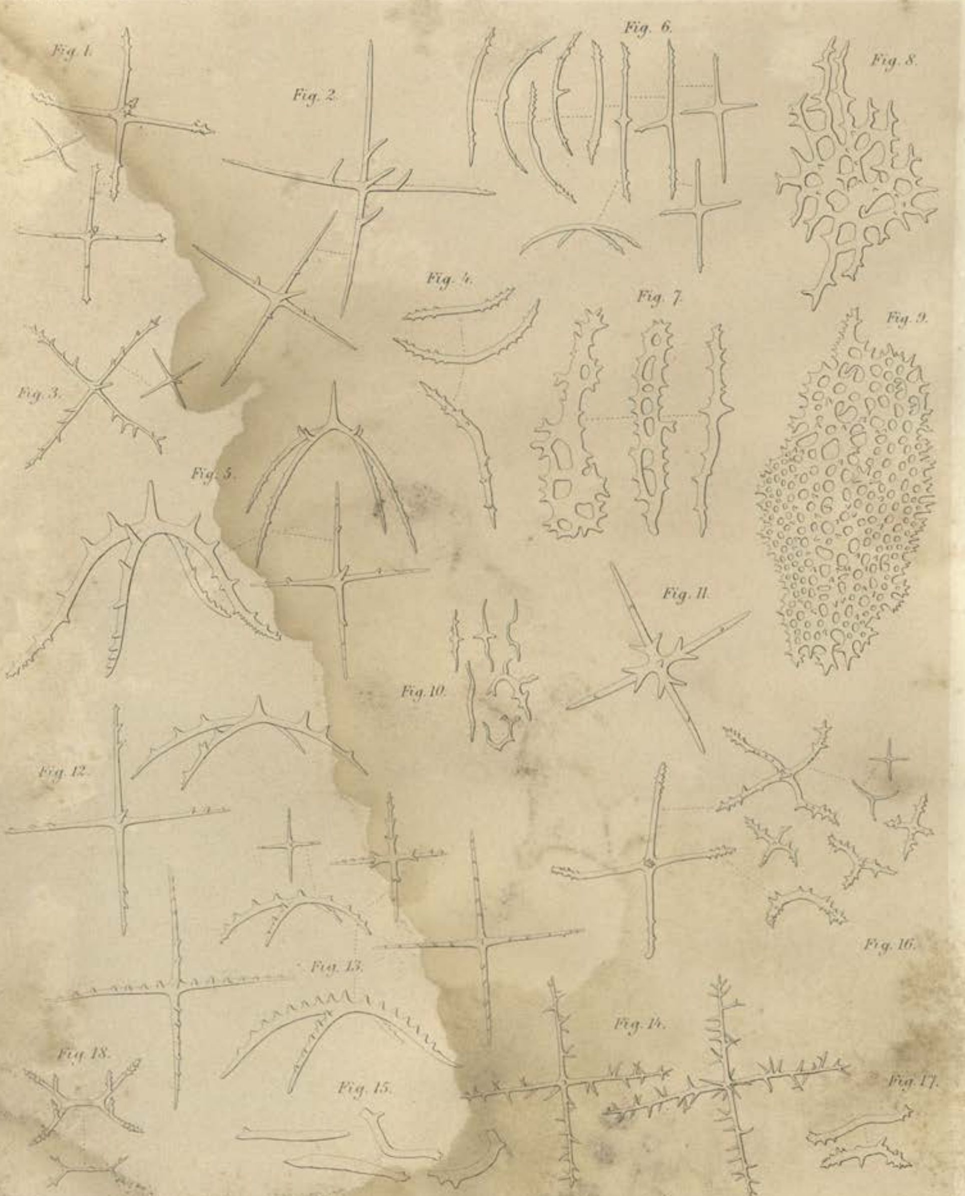
OF THE BOMBAY BRANCH



H. Théel del.

F. Huth, Lith. Edin.

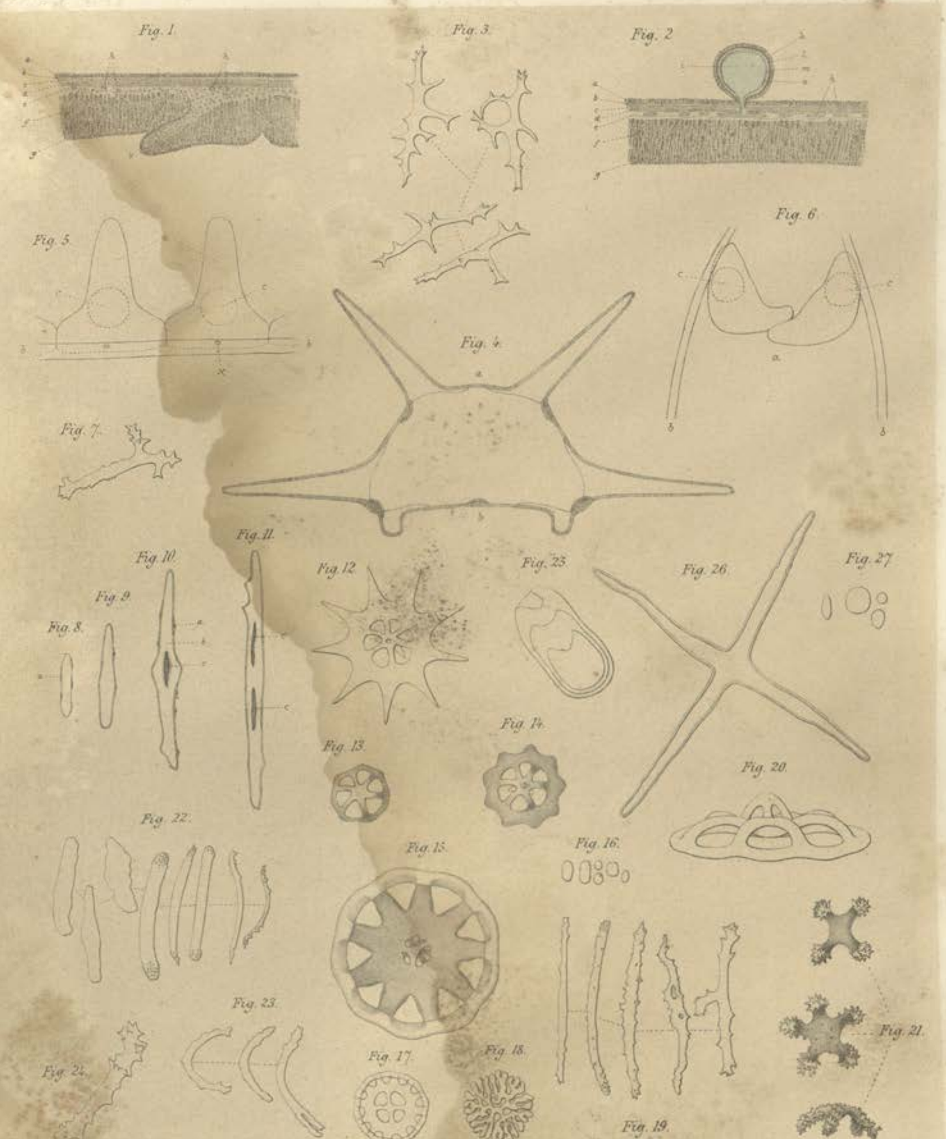
1 LÆTMOGONE WYVILLE-THOMSONI, Théel. 2 SCOTOPLANES MURRAYI, Théel. 3-4 ELPIDIA VERRUCOSA, Théel.
5 KOLGA NANA, Théel. 6-7 SCOTOPLANES ROBUSTA, n. sp. 8-9 SCOTOPLANES GLOBOSA, Théel.
10-11 PSYCHROPOTES SEMPERIANA, n. sp. 12-13 PENIAGONE AFFINIS, n. sp. 14 BENTHODYTES PAPILLIFERA, n. sp.
15-16 ORPHNURGUS ASPER, Théel. 17-18 PENIAGONE VITREA, n. sp.



H. Théel del.

F. Huth Lith.r Edin.r

1-3 PSYCHROPOTES LOVÉNI, n. sp. 4 BENTHODYTES TYPICA, n. sp. 5-6 EUPHRONIDES DEPRESSA, n. sp.
7-10 DEIMA FASTOSUM, Théel. 11 PSYCHROPOTES LONGICAUDA, var. FUSCO-PURPUREA, n. sp.
12 PSYCHOTREPHOS EXIGUA, n. sp. 13-17 PSYCHROPOTES LONGICAUDA n. sp. 18 SCOTOANASSA DIAPHANA, n. sp.



H. Théel, del.

F. Huth, Lith.r Edin.r

1-2, ONEIROPHANTA MUTABILIS, Théel. 3, LÆTMOGONE WYVILLE-THOMSONI, Théel. 4, DEIMA VALIDUM, Théel.
5-6, SCOTOPLANES GLOBOSA, Théel. 7, DEIMA FASTOSUM, Théel. 8-11, ONEIROPHANTA MUTABILIS, Théel.
12-19, ILYODÆMON MACULATUS, Théel. 20-24, LÆTMOGONE VIOLACEA, Théel. 25, KOLGA NANA, Théel.
26-27, BENTHODYTES ABYSSICOLA, n. sp.

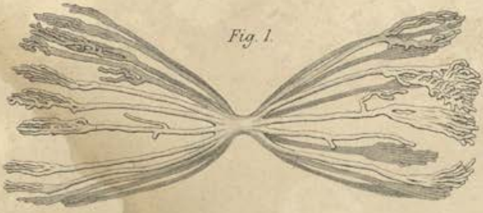
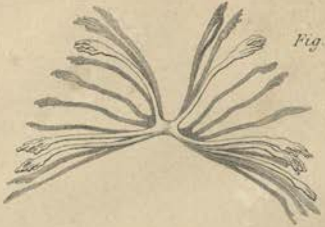


Fig. 1.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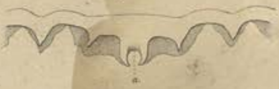
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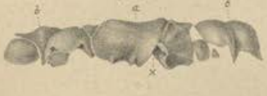
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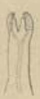
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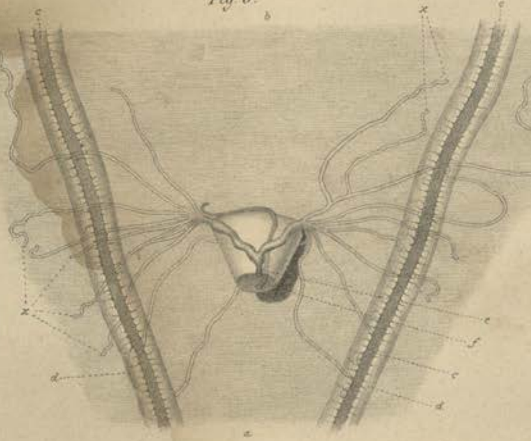
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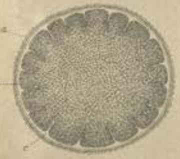
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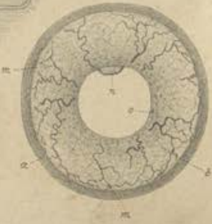
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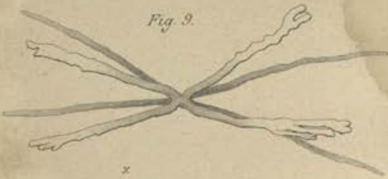
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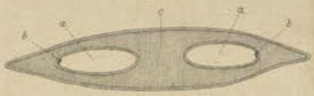
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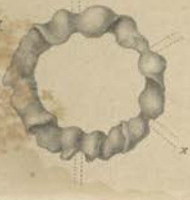
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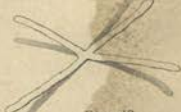
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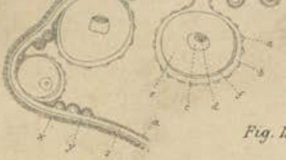
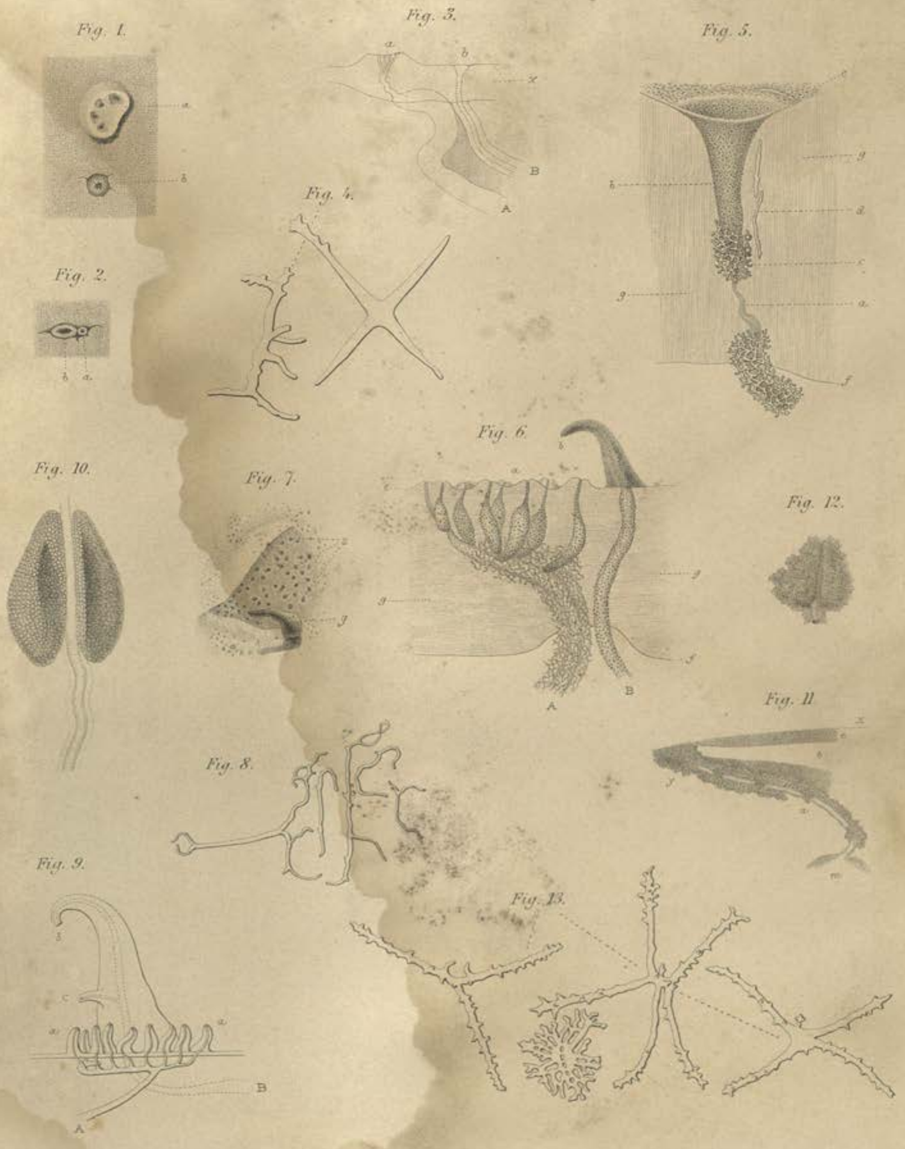


Fig. 13.

H. Théel del.

F. Huth, Lith^r Edin^r

1 ELPIDIA WILLEMOESI, n.sp. 2 PARELPIDIA ELONGATA, Théel. 3 DEIMA FASTOSUM, Théel. 4 ONEIROPHANTA MUTABILIS, Théel.
5 LÆTMOGONE WYVILLE-THOMSONI, Theel. 6 PENIAGONE WYVILLII. n.sp. 7 LÆTMOGONE WYVILLE-THOMSONI, Théel.
8 DEIMA VALIDUM, Théel 9 SCOTOPLANES ROBUSTA, n.sp. 10 PSYCHROPOTES LONGICAUDA, n.sp.
11 LÆTMOGONE WYVILLE-THOMSONI, Théel. 12 SCOTOPLANES PAPILLOSA, Théel. 13 ONEIROPHANTA MUTABILIS, Théel.

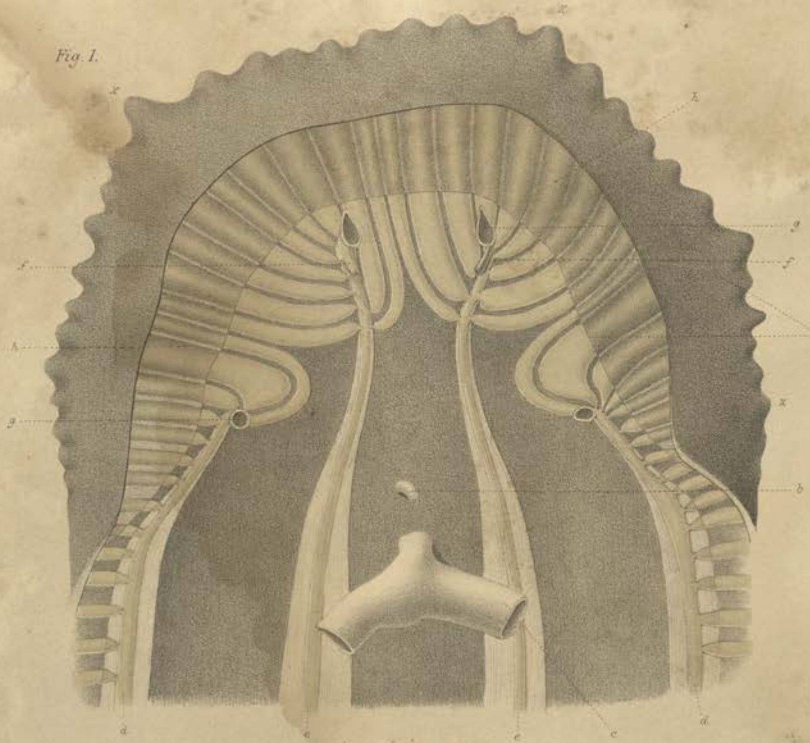


H. Théel del.

F. Huth, Lith.r Edin.r

1-4 BENTHODYTES ABYSSICOLA, n. sp. 5 BENTHODYTES TYPICA, n. sp. 6-8 ILYODÆMON MACULATUS, Théel.
9 LÆTMOGONE WYVILLE-THOMSONI, Théel. 10 ORPHNURGUS ASPER, Théel. 11-12 ONEIROPHANTA MUTABILIS, Théel.
13 BENTHODYTES SORDIDA, n. sp.

Fig. 1.



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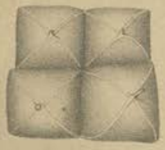

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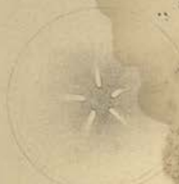

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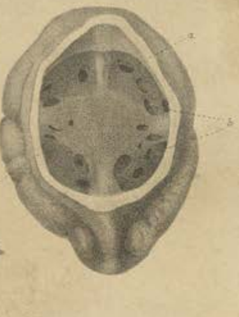
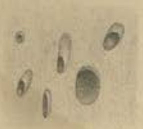


Fig. 3.



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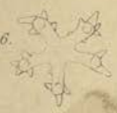

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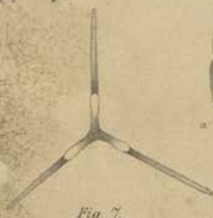
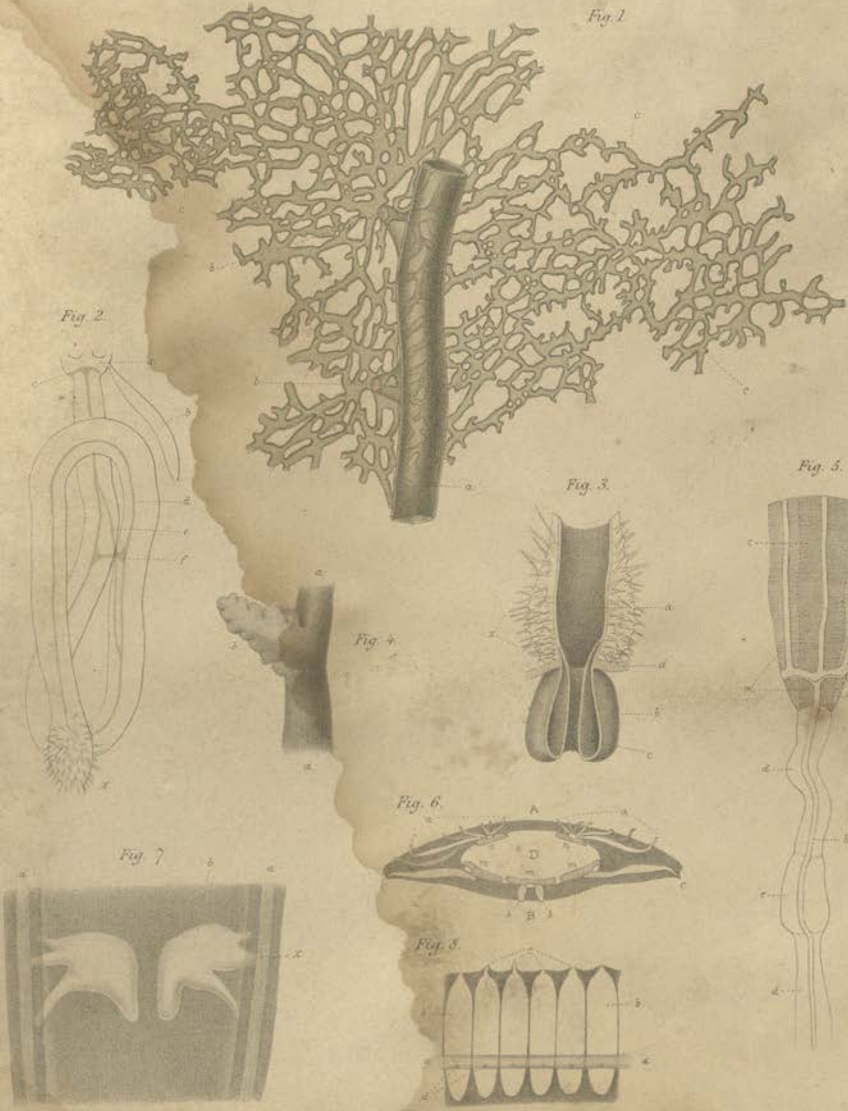


H Théel del.

F Huth, Lith^r Edin^r

1, PSYCHROPOTES LONGICAUDA, var. MONSTROSA, n. 2, ELPIDIA VERRUCOSA, Théel.
3, ACHLYONICE PARADOXA, Théel. 4, LÆTMOGONE WYVILLE-THOMSONI, Théel.
5-6, LÆTMOGONE SPONGIOSA, Théel. 7, ACHLYONICE PARADOXA, Théel.

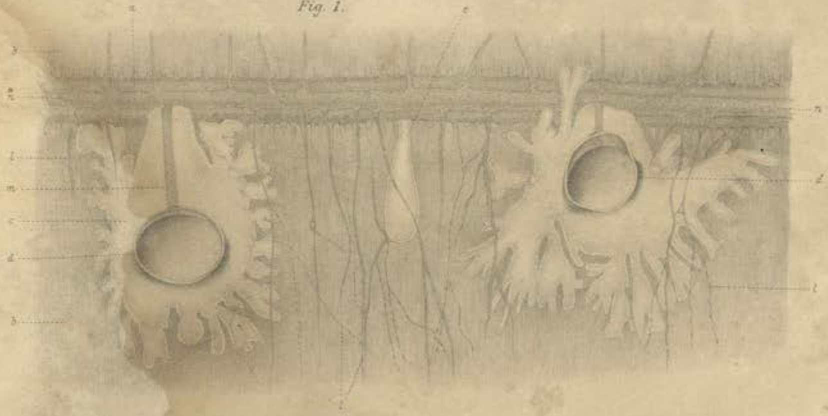


H. Théel del.

F. Huth, Lith.r Edin.r

1-3, ONEIROPHANTA MUTABILIS, Théel. 4-5, BENTHODYTES SANGUINOLENTA, n. sp.
6, BENTHODYTES SANGUINOLENTA, var. MARGINATA, n. 7, EUPHRONIDES DEPRESSA, n. sp.
8, BENTHODYTES SANGUINOLENTA, var. MARGINATA, n.

Fig. 1.



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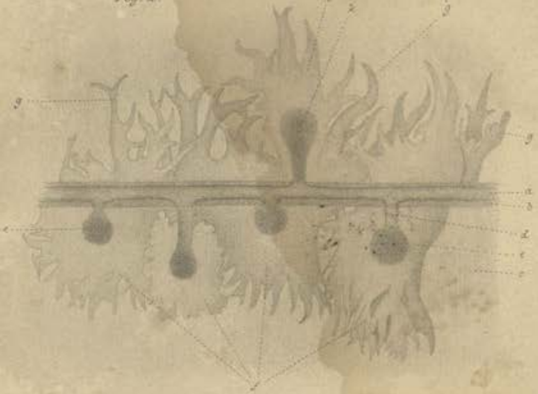

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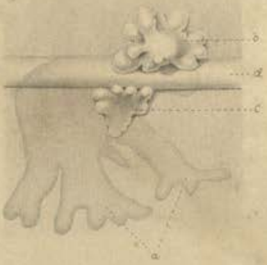
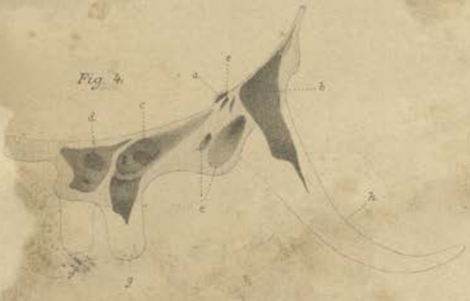


Fig. 4.



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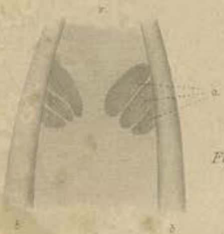
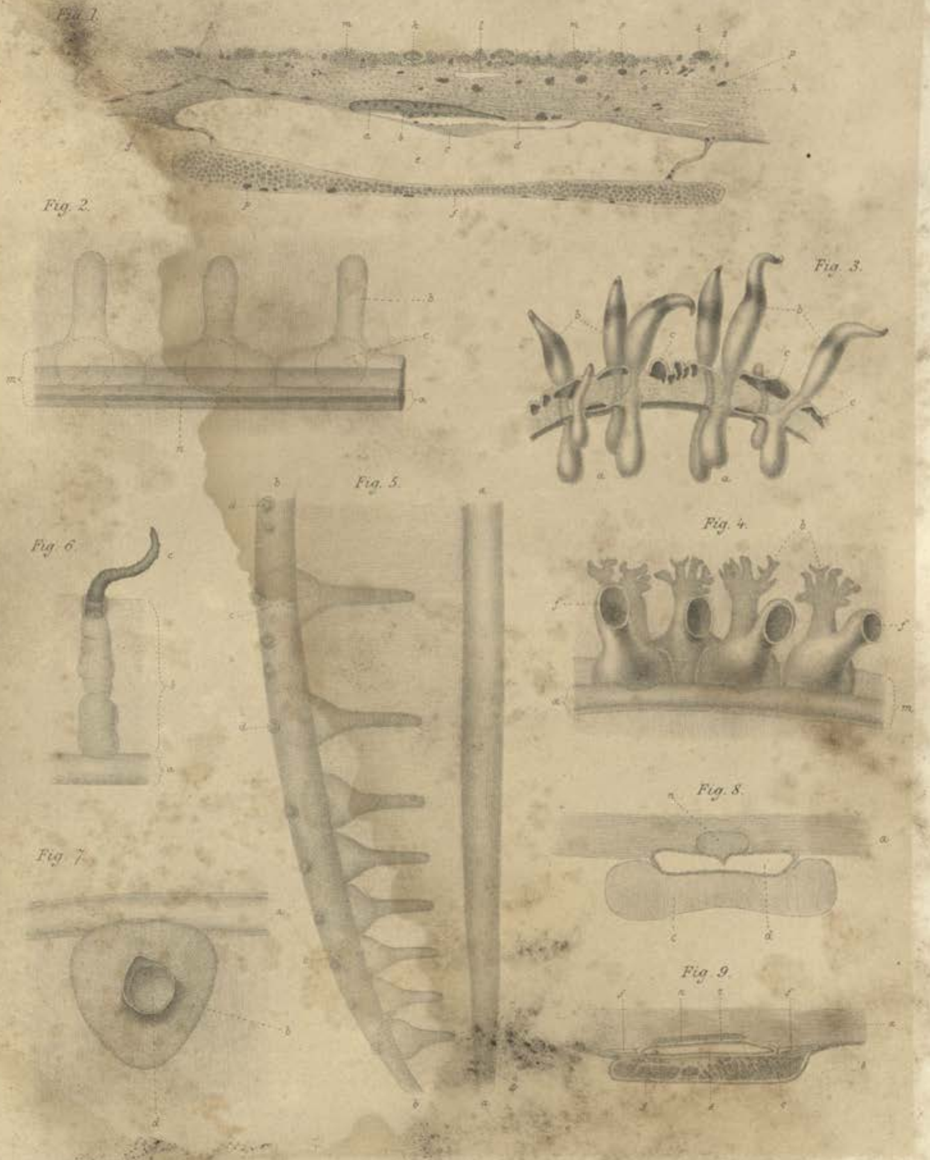


H. Théel del.

F. Huth, Lith^r Edin^r

1-2 ONEIROPHANTA MUTABILIS, Théel. 3 ORPHNURGUS ASPER, Théel.
4 ONEIROPHANTA MUTABILIS, Théel. 5 ACHLYONICE PARADOXA, Théel.



H. Théel del.

F. Huth, Lith^r Edin^r

1-2 LÆTMOGONE WYVILLE-THOMSONI, Théel. 3-4 ILYODÆMON MACULATUS, Théel. 5 KOLGA NANA, Théel.
6 BENTHODYTES SANGUINOLENTA, n. sp. 7 LÆTMOGONE WYVILLE-THOMSONI, Théel. 8 KOLGA NANA, Théel.
9 ONEIROPHANTA MUTABILIS, Théel.

Fig. 1.

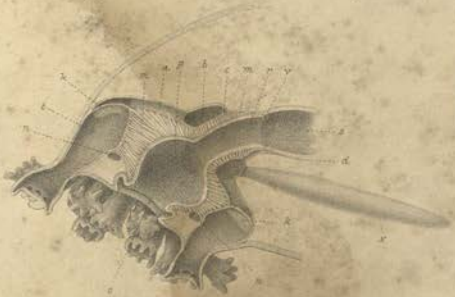


Fig. 2.

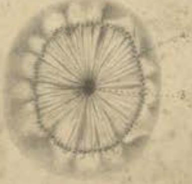


Fig. 3.

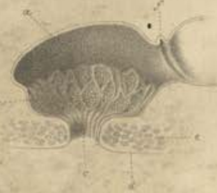
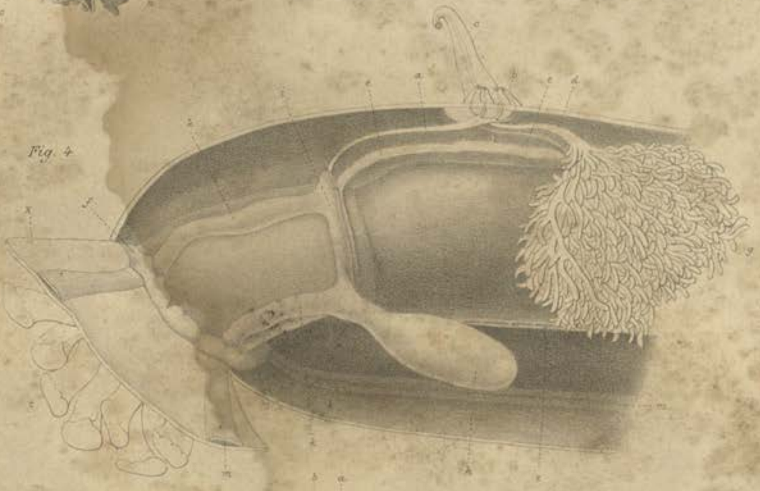


Fig. 4



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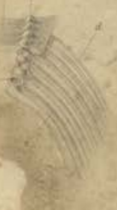

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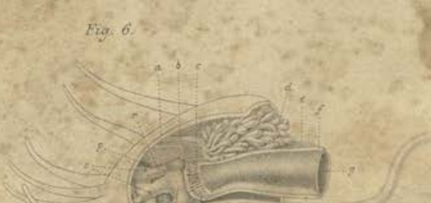

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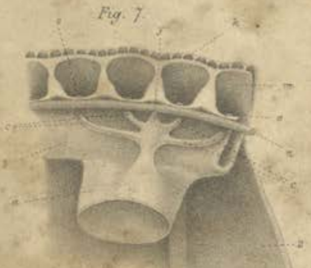
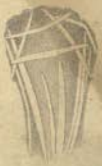


1 ONEIROPHANTA MUTABILIS, Théel. 2-3 DEIMA FASTOSUM, Théel.
4 LÆTMOGONE WYVILLE-THOMSONI, Théel. 5 DEIMA FASTOSUM, Théel.
6 ONEIROPHANTA MUTABILIS, Théel. 7 DEIMA VALIDUM, Théel.

Fig. 1.



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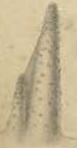


Fig. 3.

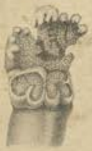


Fig. 4.

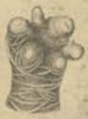
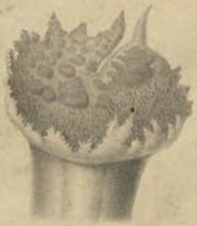


Fig. 5.



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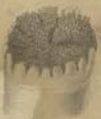

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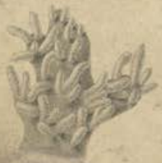

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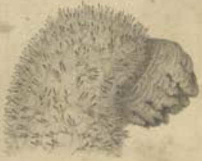


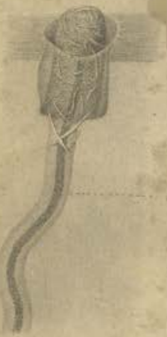
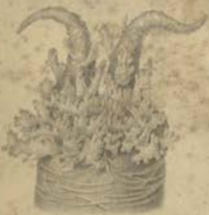


Fig. 8.

Fig. 9.



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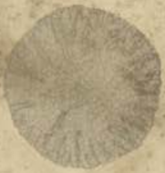

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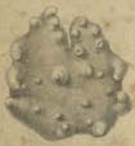

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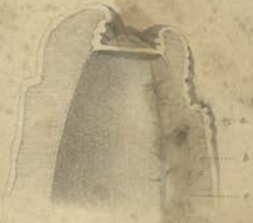


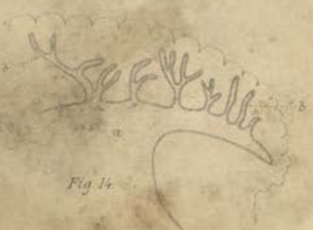


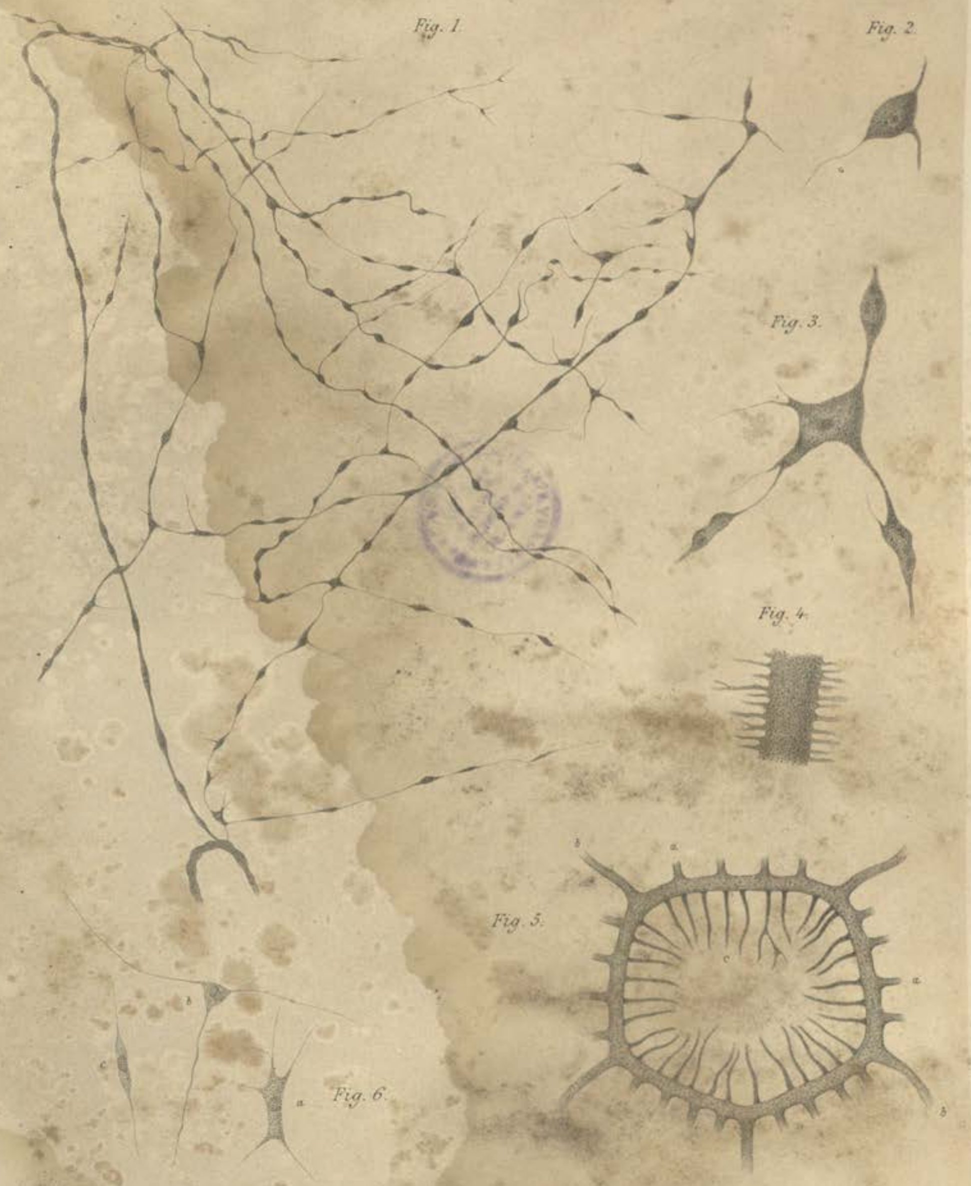
Fig. 14.

H. Théel del.

F. Huth, Lithr. Edinr.

1 PSYCHOTREPHOS EXIGUA, n. sp. 2 SCOTOPLANES MOLLIS, Théel. 3 ORPHNURGUS ASPER, Théel.
4 SCOTOPLANES MURRAYI, Théel. 5 PENIAGONE WYVILLII, n. sp. 6 ELPIDIA PURPUREA, n. sp.
7 PENIAGONE WYVILLII, n. sp. 8 BENTHODYTES TYPICA, n. sp. 9 SCOTOANASSA DIAPHANA, n. sp.
10 PENIAGONE VITREA, n. sp. 11 ILYODÆMON MACULATUS, Théel. 12 SCOTOPLANES GLOBOSA, Théel.
13 DEIMA VALIDUM, Théel. 14 LÆTMOGONE WYVILLE-THOMSONI, Théel.

THE BOMBAY BRANCH OF THE ASIATIC SOCIETY



H. Théel del.

F. Huth, Lith.r Edin.r

ONEIROPHANTA MUTABILIS, Théel.

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY.

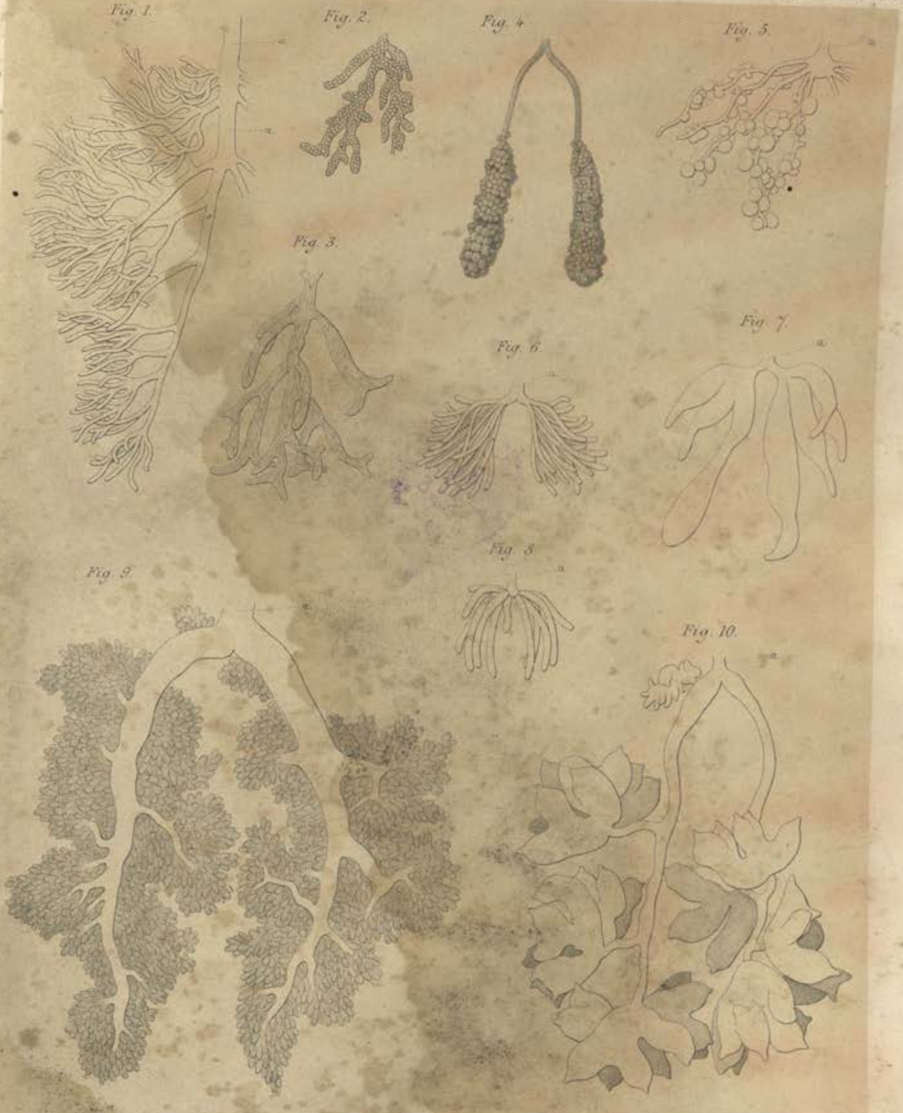


Fig. 1.
a
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Fig. 2.
Fig. 4.
Fig. 5.
Fig. 3.
Fig. 6.
a
Fig. 7.
a
Fig. 8.
a
Fig. 9.
Fig. 10.
a

H. Théel del.

F. Huth, Lith^{r} Edin^{r}

1 ILYODÆMON MACULATUS, Théel. 2-3 LÆTMOGONE WYVILLE-THOMSONI, Théel. 4 EUPHRONIDES DEPRESSA, n. sp.
5 DEIMA VALIDUM, Théel. 6-7 ONEIROPHANTA MUTABILIS, Théel. 8 DEIMA FASTOSUM, Théel.
9-10 BENTHODYTES ABYSSICOLA, n. sp.

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